SHOUT
SHARE
IT

Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 1001

Contribution from the Office of Farm Management and Farm Economics
H. C. TAYLOR, Chief

Washington, D. C. February 23, 1922

THE RELATION OF LAND TENURE TO THE USE OF THE ARID GRAZING LANDS OF THE SOUTHWESTERN STATES

By

E. O. WOOTON, Assistant Agricultural Economist

(Section of Land Economics, L. C. GRAY, Economist in Charge)

CONTENTS

	Page
Introduction	1
The Region	3
Some Factors Controlling Stock Raising on Arid Grazing Lands	9
The Natural Conditions	9
The Resultant Forage Crop	13
The Land Tenure	15
Some Consequences of the Open-Range Method of Stock Raising	28
Some Benefits Arising from Fencing the Range and Controlling the Methods of Use	36
The Necessary Legislation	42
Basic Assumptions	42
Requirements that Must be Met	44
Methods Proposed	45
Conclusion	62
Appendices	63
Bibliography	68

WASHINGTON
GOVERNMENT PRINTING OFFICE
1922

UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 1001

Contribution from the Office of Farm Management
and Farm Economics
H. C. TAYLOR, Chief

Washington, C. C. February 23, 1922

THE RELATION OF LAND TENURE TO THE USE OF THE ARID GRAZING LANDS OF THE SOUTHWESTERN STATES

By E. O. Wooton, *Assistant Agricultural Economist.*
(Section of Land Economics, L. C. Gray, Economist in Charge.)

CONTENTS.

	Page.		Page.
Introduction	1	Some benefits arising from fencing the range and controlling the methods of use	36
The region	3	The necessary legislation	42
Some factors controlling stock raising on arid grazing lands	9	Basic assumptions	42
The natural conditions	9	Requirements that must be met	44
The resultant forage crop	13	Methods proposed	45
The land tenure	15	Conclusion	62
Some consequences of the open-range method of stock raising	28	Appendices	63
		Bibliography	68

INTRODUCTION.[1]

A large part of the land of the western half of continental United States, probably from one-half to two-thirds of the total area, can not be used for the growing of field crops, mainly because the rainfall which it receives is insufficient for the growth of any known cultivated plants. The precipitation, however, is enough for the production of a growth of native vegetation which furnishes excellent, though sparse, forage for grazing animals.

Practically all of this land is now in use as grazing land, and has been so used for the last 25 to 50 years. Because no other profitable use for the land has yet been found, the grazing industry has become one of the leading, if not the leading, industry in many of the Western States. It is probable that in the case of more than 95 per cent of the public land yet unreserved and unappropriated the failure to

[1] This bulletin has been prepared under the immediate direction of Dr. L. C. Gray, Economist in Charge of Land Economics, Office of Farm Management and Farm Economics. In the preparation of this bulletin the writer has used freely information obtained from many sources, some of which can not be referred to in the literature of the subject because it has not been published. He is very grateful for the courtesies extended, and takes this means of acknowledging his indebtedness and expressing his thanks.

appropriate is due to the fact that under existing laws the land could not be obtained in areas of proper size for efficient operation. There is little question as to the accuracy of this generalization, and it is basic to all of the conclusions that will be presented in this bulletin.

From the very beginning of the use of the arid grazing lands, the fact that our existing land laws were but poorly adapted to them has been pointed out,[2] but, so far, although attempts have been made to pass land laws that will fit the special conditions of the region, it is believed that the problem is not yet solved. The grazing industry which has grown up under these handicaps has now reached a stage in its development at which normal growth must cease and retrogression may be expected to occur if some legislation adapted to its needs be not passed.[3]

Because an increase in the total production of meat animals and their by-products is not only highly desirable but easily possible on these arid grazing lands under an improved system of management, it becomes important that the factors that enter into the problem be carefully stated.

Basic to a much needed general improvement in range management is legal right of some kind to definitive control of the land by the user, which must carry with it the right to subdivide the range lands with fences. The existing Federal land laws operate in such a manner as to make an open range system compulsory, though this result is purely incidental rather than the intent of the lawmakers. These laws were designed to suit other and entirely different conditions.

Enactment of the proper kind of legislation has been prevented hitherto, at least in part, by two sorts of public opinion, either or both of which may be changed by a better understanding of the entire problem. These opinions are held by two different groups of people—the general public of the thickly populated humid region and the stockmen of the western grazing region. The great majority of our people have little knowledge of or interest in the problem (in spite of the fact that they are intimately concerned), and, because of their environment, have no standards by which to judge the merits of this particular case. On account of the sad experiences of previous generations, they are afraid to permit individuals to have legal control of large areas of land. Yet the productivity of the lands under consideration is so small that the users must have control of very large areas in order successfully to carry on the only kind of agricultural industry the land will sustain. Stockmen, though vitally concerned, have been slow to give a vigorous expression

[2] Powell, J. W., Report on the Lands of the Arid Region of the United States. House Ex. Doc. 73, 45th Cong., 2d sess., 1878.

[3] This is as important to the consumer of meat as it is to the producer of range stock, though the former may not be aware of it.

of unified opinion as to what should be done. While local differences in the changes needed have been partly responsible for this condition, the main cause has been the fear that any changes might be unfavorable to them individually. Such conditions are now largely past, and opinion among the stockmen is becoming very definite. They know what is desirable and why it is necessary and are taking steps to inform the public.[4]

As an illustration of the results of the present system of land tenure in a specified region, extracts (with maps) from an unpublished report to the Secretary of Agriculture on "An Investigation of Conditions of the Grazing Land Lying within the Limits of the Atlantic and Pacific Railroad Land Grant"[5] are included in this bulletin. These extracts show (1) the character and distribution of the principal range plant associations which form the range stock feed of Arizona and New Mexico, (2) the character of the present legal tenure of the land within the boundaries of the Atlantic and Pacific Railroad Land Grant, (3) some data on the effects of the drought of 1917–18 in Arizona and New Mexico, with (4) a summary of the experience and opinions of some stockmen of that region. It must be understood that every region has its own plant associations which constitute the native forage crop, some of which are better and some poorer than those shown for New Mexico and Arizona; that the land tenure condition shown in the maps (figs. 3, 4, and 5) is about as complex as any that exists in the arid region; and that the drought of 1917–18 in Arizona and New Mexico was really not very severe nor long continued as compared with others that have occurred in that region. While a single concrete case taken from any region can not illustrate all the factors that must be recognized in a consideration of the whole problem, the most important factors are here presented with the force of a statement of actual fact in support of the conclusions reached. The area examined is so large that the conclusions reached are believed to possess great weight.

THE REGION.

The area to which the following generalizations directly apply is that part of the arid Southwest included in Arizona and New Mexico.

[4] In presenting the ideas contained in this bulletin it will be necessary repeatedly to point out how this or that affects the range stock raising industry and stockmen. This continual reference arises from the fact, already stated, that the land will not sustain any other form of agricultural industry. Wherever this statement does not apply, the land is not arid grazing land in the sense in which the expression is here used. No attempt is made here to discuss dry farming conditions and practices. Though stock be grazed upon native grass pastures on such farms, stock raising is but one of the enterprises on what are essentially farms. The lands referred to in this bulletin are range grazing lands upon which the raising of stock is the only enterprise possible. (See page 7.)

[5] An investigation and report made by E. O. Wooton of the Office of Farm Management and Farm Economics, and Robert R. Hill, Grazing Examiner of the Forest Service, in 1919. During 1917 and 1918 a drought occurred in New Mexico and Arizona which resulted in a greatly diminished output of meat animals. The investigation was made to ascertain what might be done to reduce the consequent losses to a minimum and to prevent, as far as possible, a recurrence of such conditions.

SUMMARY.

CLIMATIC and other natural conditions so limit the utilization of a large part of the area of the 11 Western States that this area can not be used agriculturally for anything but range grazing. Yet our land laws are such that improvement in the use of the land for this purpose is very difficult, while continued misuse of large areas of both public and private grazing land is made, in effect, compulsory. This bulletin discusses the evils that arise in this connection and the remedies that have been suggested.

Extension of the homestead policy, by gradually increasing the area that may be homesteaded, has not solved the range problem, since that plan assumes the possibility of substituting some more complex type of agricultural use for the grazing industry that now occupies the land. Legislation which breaks up the use areas into holdings too small for economic use results in loss to all concerned without establishing a more productive industry than that now using the land. The homesteading of lands which may be profitably cultivated is a different matter; such lands are not included in this study, which deals only with arid grazing lands.

Sale and exchange of restricted areas, while valuable as a means of consolidating use areas, are at best but expedients of local application. The issuance of lieu land scrip for lands surrendered to the Government is of still more restricted use, as a general policy.

A leasing system, properly administered, has certain important advantages not possessed by any of the above-mentioned methods of disposal.

A permit system, like that now in operation in the national forests (though not necessarily duplicating it), is probably the best system yet devised. Such a system would prevent the disruption of the existing industry, avoid the losses that result from enlarging the homestead area, recognize the equities of present users, giving proper adjustments of claims, protect and encourage the industry for which the region is adapted, set in motion a procedure that would automatically but gradually reduce the size of all excessively large holdings, and establish that individualized control of the lands under competent supervision which is so necessary for the further development of the live-stock industry on these arid grazing lands. Not the least of the advantages of the permit system lies in the fact that it does not of necessity interfere with nor replace the existing land laws, but makes easier the administration of these laws.

The illustrative material refers to all or a selected part of this area. Most of these statements apply more or less directly to a much larger region—the arid grazing lands of the Western States—which may be roughly outlined as including the great basin region (the southeastern corner of Oregon, the southwestern corner of Idaho, the part of Wyoming west of the Rocky Mountains, the part of California east of the Sierra Nevadas, and practically all of Nevada and Utah), all of Arizona and New Mexico, and the part of Texas west of the Pecos River (but not including the crop and forest lands within these boundaries).

The statements relative to the natural and managerial factors controlling the stock-raising industry will doubtless apply rather closely over all the region indicated. The conditions of land tenure and their consequences differ more or less with each State. Any recommendations as to changes in land policy must necessarily take these conditions into consideration.

About one-third of this great region, or approximately 200 millions of acres, is to-day open for entry by homesteaders—an area larger than the occupied land of the original 13 colonies when this Nation was founded. All of this land long ago would have passed to private ownership if it had been productive agricultural land or if there had been any way of getting control of large enough bodies of it for private use as grazing land.

The different classes of land.—On a basis of possible use the lands of the western United States may be classified in a broad way as follows (see bibliography, section 3):

"Desert" lands are those where the average annual rainfall is so small [6] —usually less than 6 inches—that there is very little if any permanent drinking water for stock, and consequently year long grazing is not practicable. Of course, cultivation of any known crop on this land without irrigation is an impossibility.

"Arid grazing lands" are those where yearlong or seasonal grazing is assured, but where any kind of cultivation of crops is possible only a small part of the time or not at all, and upon only a very small part of the area. The average annual rainfall of this area ranges from about 6 to 15 inches.

Where the average annual rainfall is from 15 to 20 inches cultivation of certain crops is often possible when topography, soil conditions, and the seasonal distribution of rainfall are favorable and the growing season is long enough; but the farm practices are those of the system called "dry farming" and the land is here called "semi-arid" or "dry-farming" land.

[6] The average annual rainfall is used merely as a rough means of limiting areas. It is not a good measure to use for anything more than such approximations, but it is the only one now available. It must not be taken to mean the amount of water available to growing plants.

The "humid region" [8][7] is that area in which some sort of crop may be produced on cultivated land every year. Except for small areas in the higher mountains to the south or on the higher plateaus or valleys to the north this humid region occurs east of the ninety-seventh meridian or west of the Cascade Mountains. Irrigated lands would fall in this class; although they are not in a humid region, the growing conditions supplied the plants are those of a humid region.

"Forests" and "woodlands" [8] are, as the terms imply, the tree-bearing areas. In the region under consideration they lie, for the most part, within the national forests. In so far as they have grazing uses they are now very properly treated as arid grazing land, with scattered small areas of dry-farming land interspersed. However, they are not considered as belonging in the area here referred to as arid grazing land which lies outside the national forests.

Of course, these subdivisions are more or less arbitrary, but they are necessary in order that we may consider the best utilization of the different regions with some degree of accuracy.

There is a belt or zone between the farming land of the humid region and that of the semiarid region that may be handled as humid farming land only part of the time, and an adjustment in the cropping systems is necessary to meet this condition. Likewise there is a belt between the dry-farming land and the arid grazing land, in which part of the land may be dry farmed with success only part of the time. And there is a strip around the desert area that may be grazed for a longer or shorter time at irregular intervals, but not throughout the year at any time, and frequently not at all during a given year.

These areas of variable productivity cause much trouble when an attempt is made to show upon the map the boundaries of each kind of land, because the boundary is a zone and not a line. These transition areas will not continuously produce when operated under the more complex type of organization to which they are occasionally adapted; hence they must be operated all the time under a lower, but safe type, and the system of management made flexible enough to accommodate itself to the periods of more than the assured production.

The determining natural conditions are not the average climatic conditions. They are the absolute minima, and the relative frequency with which these minima may be expected to occur. We do not need to be told that citrus fruits can not be grown with profit in a region where the temperature goes to zero for a longer or shorter time one year in five, no matter what it may do the other four years; but it seems to be necessary to demonstrate by trial and failure that

[7] The bracketed figures used throughout this bulletin refer to the publications listed in the bibliography on pages 68 et seq.

crop farming can not be made to support families on land where periods of drought lasting one, two, three, and even four or five seasons in succession are known to occur with more or less regularity—periods of drought so severe that no known cultivated plants can be expected to endure them and produce a crop.

The approximate geographical distribution of the lands of each class is shown in the accompanying diagrammatic map (fig. 1). At

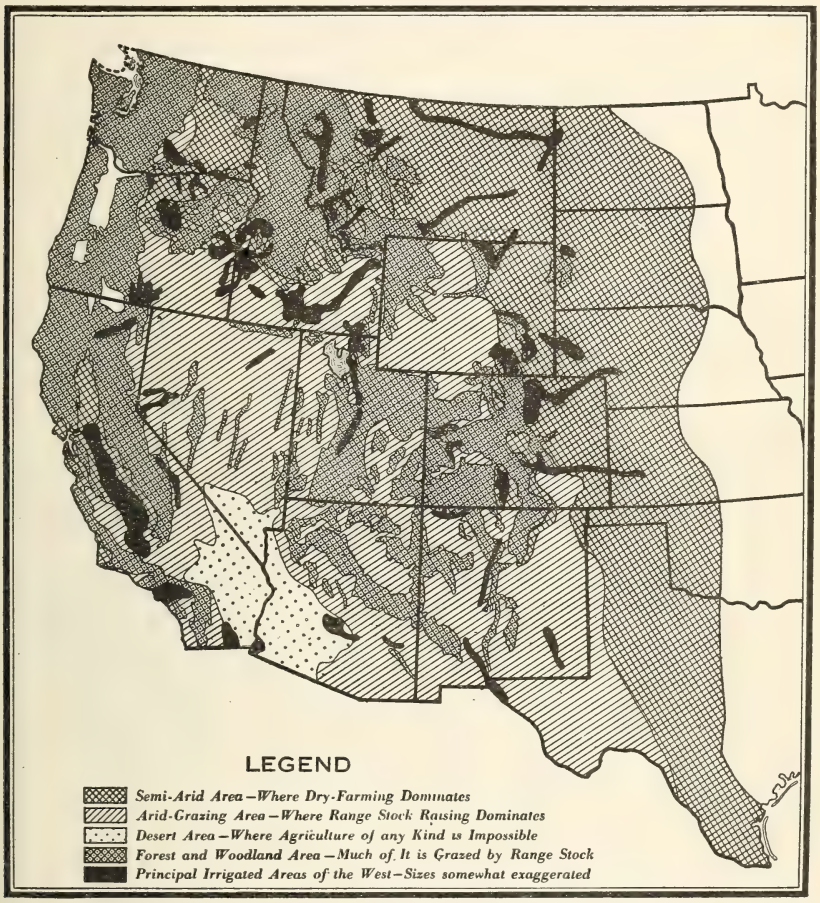

LEGEND
Semi-Arid Area—Where Dry-Farming Dominates
Arid-Grazing Area—Where Range Stock Raising Dominates
Desert Area—Where Agriculture of any Kind is Impossible
Forest and Woodland Area—Much of It is Grazed by Range Stock
Principal Irrigated Areas of the West—Sizes somewhat exaggerated

FIG. 1.—Diagrammatic map of the western half of the United States, showing roughly the geographic distribution of the different classes of land as determined by the dominant agricultural use.

no place are the boundaries between areas of the different classes as well defined as the lines on the map would suggest. Many small areas of irrigated or dry-farming land occur in the forest and woodland area, and some occur in the arid grazing area. Likewise in the semiarid area there are many places, usually of relatively small size, where the land can be used only for grazing. Irrigable land is, of course, always capable of intensive cultivation and occurs wherever

irrigation water may be had. It is believed that much of the great plains region in eastern Montana and Wyoming, shown here as dominantly dry-farming land, will ultimately prove to be arid grazing land.

Definite data as to the area of each class of land to be found in the western United States are not available, but there are estimates and in some cases exact figures from which an approximation may be reached.[8] Using the more reliable of these figures and assuming (1) that the humid crop lands west of the Sierras (outside the National Forests) amount to as much as 20 millions of acres (which is certainly ample) and (2) that there is at least as much arid grazing land in these 11 States as there is semiarid crop land (which is certainly an estimate in favor of the dry-farming land), the following results are obtained:

Classification of land in the 11 Western States.

Class of land.	Acres.	Per cent.	Class of land.	Acres.	Per cent.
Humid crop land	20,000,000	2.67	Forest and woodland	128,000,000	17.09
Irrigable crop land	41,000,000	5.47	Desert land	40,000,000	5.35
Semiarid crop land	260,000,000	34.71			
Arid grazing land	260,000,000	34.71	Total	749,000,000	100.00

[8] Below are presented the data relative to the various classes of lands in the 11 Western States, showing approximate area of each kind, in nearest whole number of millions of acres.

States.	Total land area.	Area of national forests.[1]	Desert area.[2]	Area possible of irrigation.		Area for which water is available.		
				Fortier.[3]	Newell.[4]	As shown by United States reclamation projects, 1918.[5]	Reported by Census for 1910.[6]	Total area in all projects, Census 1910.[7]
Arizona	73	11	10	1	2	0.25	0.39	0.94
California	100	19	20	10	17	.05	3.62	5.94
Colorado	66	13	.....	3	8	.14	3.99	5.92
Idaho	54	18	.....	5	5	.55	2.39	3.59
Montana	93	16	.....	6	11	.16	2.21	3.52
Nevada	70	5	10	2	2	.07	.84	1.23
New Mexico	78	8	.....	2	4	.12	.64	1.10
Oregon	61	13	.....	3	3	.07	.83	2.53
Utah	53	7	.....	2	4	.05	1.25	1.95
Washington	43	10	.....	1	3	.14	.47	.82
Wyoming	62	8	.....	6	9	.13	1.64	2.22
Total	749	128	40	41	68	1.73	19.33	31.11

[1] United States Forester's Annual Report for June 30, 1919. This includes most of the forest and woodland area. State and private holdings are not included in these figures; they amount to several millions of acres.

[2] Rough estimate, based mainly upon the area receiving less than 5 inches average annual rainfall. The area is certainly more than 25 and less than 50 millions of acres in extent.

[3] Fortier, Samuel, et al. National Conservation Commission's Report. Senate Doc. 676, 60th Congress, 2d session, 1909. Vol. 2, p. 67.

[4] Newell, F. H. Irrigation, 1906. These figures assume complete conservation and use of all water resources of each State.

[5] Annual Report Reclamation Service for 1918. Figures show amount of water available for irrigation under United States reclamation projects, not all of which was used.

[6] Statistical Abstract, 13th Census Report. Total area for which water was available in 1910. These figures have doubtless been increased somewhat in the last decade, but the new data are not yet available.

[7] Same. Total area included in projects of all kinds in these States in 1910. In addition, there was in Kansas, Nebraska, North Dakota, Oklahoma, South Dakota, and Texas water for 1.06 millions of acres and 1.84 millions of acres of land in projects already in operation.

Since nearly all of the forest and woodland is operated as arid grazing land, it follows that over half of the area of the 11 Western States is used as arid grazing land and must continue to be so used. Practically all the Government land remaining unreserved is arid grazing land and lies scattered in smaller or larger parcels among lands of other tenure in all of these States. Hence the conclusion is reached that the land policy under which the disposal of these lands is made is of great importance to one of the principal industries, occupying about half the area in the western half of the country, and employing many people.

SOME FACTORS CONTROLLING STOCK RAISING ON ARID GRAZING LANDS.

In the business of raising stock on the arid grazing lands, practices which may be adopted are automatically limited by (1) physical or natural factors, like climate, soil, topography, etc., (2) the resultant forage crop, and (3) social and economic conditions, such as the laws and customs which determine the method of using the land, the marketing conditions, the methods of financing the business.

THE NATURAL CONDITIONS.

The natural conditions governing the stock-raising industry are those which determine the quantity and kind of feed that may be produced and the time at which it may or must be used.

The quantity of feed produced per acre in any part of the arid grazing region is usually small, much smaller than that grown on an equal area of cultivated land. Hence the area of land necessary to produce sufficient feed for an animal for one year is always large as compared with the area required to produce feed for an animal of the same kind on a farm. Rarely less than 7 to 10 acres and often more than 50 acres are required to support a mature cow, or equivalent live stock, for a year. For the southwestern states (not including the desert area) the average is approximately 30 acres per cow.

This region receives relatively little precipitation, there are a large number of clear days during the year, and ordinarily a very dry atmosphere. The plants are subjected to strong light, high daily temperatures, sudden and large changes in temperature, and a wide annual range of temperature, as well as a limited supply of moisture. The different adjustments of these factors of moisture, heat, and light, modified to a greater or less degree by the soil and topography, determine the area over which each kind of plant may grow. The combination of plants growing over an area forms the plant association for that area, and the plant association determines in a broad way the grazing capacity for live stock.

Plant and animal competition.—In any plant association there are always certain plants which, after a long enough period of adjustment, dominate all others and occupy most of the space. These are the characteristic plants of the association and their names are generally used to name the association. Sometimes these dominant species are good forage plants and sometimes they are not. Frequently the dominance of certain plants is due to some other factor than the climatic ones. A good example of this is shown in certain of the plains or prairie regions that formerly were covered with tall grasses but became brush-covered after stock were introduced. Before live stock were brought in, the grass was frequently burned over and all shrubs were killed to the ground. Grasses recover quickly from such burning while shrubs grow more slowly, and are only able to get well started by the time another fire occurs. When grazing animals are introduced and they eat the grass, there is nothing left to burn, and the shrubs reach maturity, changing the whole appearance of the region and often modifying its grazing capacity.

The introduction of grazing animals on any plant association also tends at once to change the relationships existing among the different plants of the association, because the animals do not graze equally all the plants of the association. They always select the plants they like best and eat them first. Thus there is a strong tendency for the plant that is the most palatable feed on the range to be exterminated by the animals. Especially is this the case if the range is too heavily stocked.

The plants of an association also compete among themselves for place. Hence when certain plants, that ordinarily dominate, are eaten, subordinate and usually less palatable members of the association take a higher place in the association than they normally hold. If this overloading of the range is carried to excess for some time, unpalatable weeds occupy the range. It is thus possible for any one who is conversant with the normal plant associations of a region to tell just about how badly and how long a particular range has been overstocked by observing what plants that should be present are lacking and how subordinate ones in the association have increased in importance. In extreme cases of overstocking the edible plants are practically driven out and the soil is occupied by weeds that the grazing animals never eat. A striking case of this kind is seen where the snakeweed (*Gutierrezia* spp.) has completely occupied the short-grass land.

Soil moisture and erosion.—When grazing animals reduce the total amount of vegetation on the area that they graze to such a degree as to increase the rate at which the rain water runs off, two things

have been done which tend to lower the productivity of the area. One effect is a reduction in the total amount of water that enters the soil, with a lessening of the amount available to the growing plants. The amount of feed that plants produce varies almost directly as the available water, up to the optimum amount. Therefore loss of the water means loss of feed on any arid land, because the water supply on such land is always less than might be utilized.

Another effect of the removal of the grass is an increase in the erosion produced by the water that runs off [83][9]. Nothing protects a soil from erosion so well as a thick sod of grass. Any practice which retards the rate of flow of the water reduces its erosive power many fold. All erosion takes away the finer soil and leaves a surface upon which the desirable plants will not readily grow. The process is cumulative and is often carried so far that nothing but an entirely new plant association can occupy the land and the land lies bare and unproductive for a longer or shorter period while the new association is coming in and getting adjusted. This new association nearly always starts as a scattering growth of aggressive and often unpalatable weeds.

It is very hard to maintain a balance between the maximum production of the better forage plants and the maximum number of animals that can be fed upon the area [41]; it is practically impossible to do so upon an open range, where possession is maintained only by having the land overstocked all the time.

Poisonous plants.—Certain of the plants on the ranges are poisonous to stock. The natural tendency of the animals to leave such plants alone because they are usually not palatable tends to favor them in their competition with more valuable plants, with the final result that the poisonous plants tend to increase in quantity as time goes on. Under certain circumstances poisonous plants are eaten by the animals (usually for lack of better feed) and serious losses are suffered. (See bibliography, section 9).

Wild animals.—Besides the domestic stock on a range there are always wild animals, some of which will attack the domestic stock. The extinction of these predatory animals is always an important matter in the range stock business, but when accomplished, it has a reaction which is not altogether desirable. Other wild animals, like prairie dogs and rabbits, that are normally the food of the coyotes, wolves, etc., reproduce rapidly whenever their natural enemies are removed and then they must themselves be removed or they eat up the feed that is needed for the stock. Hence there is a close relationship between the stockman's business and the work of the U. S.

[9] The transporting power of flowing water varies as the sixth power of its velocity. Le Conte, Elements of Geology, 5th ed., p. 20, 1903.

Bureau of Biological Survey in the extermination of predatory and other animals.

Watering places.—A very important controlling factor in the range-grazing industry is the available supply of stock water [60]. Throughout the arid grazing region, watering places are few in number and widely and unevenly scattered. They are frequently hard to develop and expensive, both in first cost and in maintenance. Yet because the business can not be carried on without them, much money and effort have been expended in their development and in attempts to get them properly distributed over the range.

Springs and streams (which are very rare) must be protected; reservoirs must be constructed; wells that are often several hundred feet deep must be drilled and expensive pumping machinery installed and maintained; pipe lines miles in length are often necessary. In all cases the watering place must be so arranged that the animals can get to the water easily, and at the same time the source must be protected. Reservoirs or tanks must be constructed to hold a reserve supply to tide over a breakdown in the mechanical equipment. These difficulties have been more and more effectively overcome as the industry has developed, but the investments in these watering places often represent a large part of the capital that stockmen have put into their business.

Miscellaneous factors.—The low productivity of the land makes imperative the use of a large area as a producing unit. This size factor introduces difficulties of transportation and communication that can be effectively overcome only by relatively large items of expense or capitalization or both.

A very important fact, often overlooked when estimates are being made of the area of arid grazing land necessary to support a family, is that the stock ranch furnishes very little food for the family. In this respect it is like a mine or manufacturing business instead of like a farm. Its product must all be sold and all the provisions for the ranch family must be bought.

If a stockman has children to be educated, the only way it can be done is to send them to town or hire a private instructor. One method entails the maintenance of a house in town, the other the cost of a private school. In either case the business must carry these added expenses and must produce a correspondingly larger cash income. Hence the stock ranch must produce a much larger net income than a farm which gives the same standard of living, and the income is directly dependent upon the size of the ranch.

THE RESULTANT FORAGE CROP.

Since the effects of all the physical factors working together with varying intensity are exceedingly variable over the arid grazing area, there has resulted a set of plant associations having different grazing capacities and adapted to different types of business. (See bibliography, sections 6 and 7.) Some of these areas produce winter feed only, some produce summer feed only, and some produce feed that may be used as a summer or winter or year-long range. The adjustment essential to making the best possible uses of these differing areas is a very complex problem, yet it must be solved and the solution must be upon broad lines. As an example of the resultant condition that exists in a part of the area involved, the following discussion of the main forage types in Arizona and New Mexico is presented. An analogous condition exists in any part of the arid grazing region.

An attempt is made in figure 2 to give a picture of the geographical distribution of the principal range forage plant associations found in the States of Arizona and New Mexico.[10]

This picture is drawn on broad lines and is a generalization. The boundary lines shown are only such approximations as can be made from the data available and the personal knowledge of the investigators. In fact, there are no hard and fast lines marking the boundaries of these plant associations as shown on the map, and there are frequently greater variations in grazing capacity within the limits of what are here mapped as single associations and credited with a uniform grazing capacity than the difference between the average grazing capacities of two adjacent associations. Yet the map serves to visualize the conditions that exist as well as the problem that must be solved in order that the lands may be properly utilized.

The different areas shown are occupied by plant associations that may be easily recognized by some characteristic, well-known plants. The groups are not uniform throughout their separate distribution areas, but the annual supply of forage produced by each association is fairly constant, this supply being affected only by seasonal climatic changes, more especially by the precipitation. Each range forage plant association as here conceived and presented furnishes the forage upon which the live-stock business must depend and has a fairly constant value and certain tolerably definite restrictions as to use.

In naming these associations each has been called by the name of the most characteristic and easily recognized plant, though this has led to the use of names of plants that are not themselves forage plants. For convenience of reference a number has been assigned to each association, commencing at the lowest levels on the desert.

A table of estimates of areas of each forage type in the Atlantic & Pacific Railroad land grant area, in the State, and in the two States combined, with percentages of total area in each is also given. (See Tables 1 and 2.)

[10] Taken from a report to the Secretary of Agriculture upon "An Investigation of Conditions of the Grazing Land Lying Within the Limits of the Atlantic and Pacific Railroad Land Grant." By Wooton and Hill, 1919. In compiling the map, the United States Geological Survey topographic sheets for Arizona and New Mexico were used as base maps, and published and unpublished data of this division of the service were also used. The published and unpublished life-zone maps of these two States prepared by the Bureau of the Biological Survey were freely used, as were data on plant distribution taken from Forest Service records. Plant distribution maps by Shantz and Zon and by Shreve were consulted and used whenever they were of service. The authors have had field experience in the region extending over many years and their field notes were used.

TABLE 1.—*Characteristics of the principal forage type plant associations in Arizona and New Mexico.*

Data.	Forage type No. 1, desert shrubs and annuals.	Forage type No. 2, semi-desert grassland.	Forage type No. 3, short-grass land.	Forage type No. 4, woodland.	Forage type No. 5, yellow-pine forest.	Forage type No. 6, spruce-fir forest.[3]
Characteristic plants easily recognized.	Palo verde. Palo duro. Creosote bush. Mesquite. Saguaro. Chollas. Other cacti.	Mesquite. Catclaw. Desert willow. Mormon tea. Salt bushes. Yuccas. Some cacti. Certain scrub oaks.	Short grass; no trees. Grama and buffalo grass. Rabbit brush. Small sagebrush. Apache plume. Snakeweed. Summer weeds.	Pinyons Junipers. Evergreen oaks. Mountain mahogany. Black sage. Numerous shrubs.	Western yellow pine. Gambell's oak. Wild cherry. Gooseberries. Currants. Many other shrubs. Many flowering weeds.	Douglas spruce. Colorado blue spruce. Engelmann spruce. Balsam. Aspen. Tall grasses.
Principal forage plants	Alfilerilla. Indian wheat. Annual grasses. Borages. Many other annuals. Browse on shrubs mentioned above.	Black gramas. Tobosa grass. Galleta grass. Needle grasses. Burro grass. Dropseed grasses. Salt bushes. Browse on shrub; weeds.	Blue grama. Buffalo grass, locally. Sagebrush. White sage. Some dropseed grasses. Summer weeds.	Blue grama. Sagebrush. Certain bunch grasses. Browse from oaks and shrubs. Summer weeds.	Blue grama. Colorado blue stem. Arizona fescue. Wheat grasses. Oak and other browse. Many shrubs. Many herbs.	Many tall grasses. Fescues. Poas. Red top. Timothy. Sedges. Many shrubs and herbaceous plants.
Extreme altitude,[1] range (feet above sea level).	500 to 2,000 feet	2,000 to 5,000 feet	5,000 to 7,500 or even 8,000 ft. in places, mostly between 5,000 and 6,000 ft.	5,500 to 7,500 feet, mostly 5,500 to 6,500 feet.	6,500 to 8,500 feet, mostly below 8,000 feet.	8,000 feet to timber line.
Precipitation (in inches):						
Average annual	5 to 6 inches	About 9 to 10 inches	About 11 to 12 inches	About 15 to 16 inches	About 20 inches	Probably 25 to 30 in.
Average seasonal[2]	1.5 to 2 inches	About 5 inches	About 6 inches	About 8 inches	About 8 inches	Probably 10 to 12 in.
Season forage is available.	Late winter and spring occasionally.	Yearlong	Yearlong	Yearlong	Mostly summer; yearlong in places.	Short summer season.
Kind of stock to which it is best suited.	Sheep	Cattle; breeding ranges	Cattle or sheep	Cattle or sheep	Cattle or sheep	Mostly sheep; cattle some places.
Grazing capacity (yearlong for 1 cow).	Average not better than 100 acres.	35 to 40 acres	20 to 30 acres	20 to 30 acres	25 to 27 acres	No figures available, but high for short season.
Character of stock water	None permanent; small amount in temporary pools.	Mostly wells and earth reservoirs.	Springs, wells, and reservoirs.	Springs, a few intermittent streams, reservoirs, and wells.	Springs, streams, reservoirs, a few wells.	Springs and streams mostly.
Character of utilization at present.	Not over one-half the area now utilized by sheep; a few cattle on it in places, but have to be taken off part of year.	All in use; mostly occupied by cattle, sheep from desert area forced into it; mostly very poor sheep range.	All in use by cattle and sheep, mostly as yearlong range.	All in use by cattle and sheep, mostly as yearlong range, sometimes as winter range only.	All in use, mostly as summer range for sheep and cattle, sometimes as yearlong for cattle.	Summer range only; mostly used for sheep, occasionally for cattle.
Growing season	From Dec. 1 to May 15	Shrubs and most other perennials in spring; grasses and herbaceous plants, July to October.			Shrubs in spring, mostly a summer growth.	Late spring and summer.

[1] Altitude ranges seem to overlap because the extremes of distribution are given. These are affected by slope, exposure, and other factors, so that the belt or zone of a given association of plants is higher on one side of a mountain than on the other.

[2] Seasonal precipitation refers to the amount falling between May 1 and Sept. 30. This period is not the growing season for the desert area.

[3] The very small area of mountain peaks above timber line is included in this division for convenience.

TABLE 2.—*Estimated area and percentage distribution of each forage type within the limits of the Atlantic & Pacific Railway grant and within the two States.*

IN ARIZONA.

Forage type.	No. 1. Desert shrubs and annuals.	No. 2. Semidesert grass land.	No. 3. Short-grass land.	No. 4. Woodland.	No. 5. Yellow-pine forest.	No. 6. Spruce-fir forest.	Total.
In the grant area:							
Acres	2,081,687	9,048,223	2,790,835	6,559,718	2,421,320	51,011	22,952,794
Per cent of total	9.1	39.4	12.2	28.6	10.5	0.2	100
In the State:							
Acres	17,408,378	23,963,834	9,031,961	15,878,771	5,972,749	582,707	72,838,400
Per cent of total	23.9	32.9	12.4	21.8	8.2	0.8	100

IN NEW MEXICO.

In the grant area:							
Acres	.....	901,555	3,912,584	2,765,676	1,865,180	183,260	9,628,255
Per cent of total	.....	9.4	40.7	28.7	19.4	1.8	100
In the State:							
Acres	.....	17,483,628	30,655,151	15,209,972	12,152,298	2,900,871	78,401,920
Per cent of total	.....	22.3	39.1	19.4	15.5	3.7	100

IN THE WHOLE AREA.

In the grant area:							
Acres	2,081,687	9,949,755	6,703,419	9,325,394	4,286,500	234,271	32,581,049
Per cent of total	6.4	30.5	20.6	28.6	13.2	0.7	100
In the two States:							
Acres	17,408,378	41,447,462	39,687,112	31,088,743	18,125,047	3,483,578	151,240,320
Per cent of total	11.5	27.4	26.2	20.6	12.0	2.3	100

Estimates as to the total area of land in New Mexico which may be dry farmed have run as high as fifteen millions of acres, but experience has shown that this is considerably exaggerated, since much of the land which was assumed to be proved dry farming land has since been abandoned on account of the drouths. No complete estimate for Arizona is available, the tentative figures by Clothier and McOmie ranging from one-half to one million acres for the State.

Estimates as to the amount of irrigable land in each State are given in footnote 2, on page 8. The irrigable areas for these two States and for the land grant area are included (without being indicated) in the figures given above because it is not possible to work out the details of their distribution with the information now available.

THE LAND TENURE.

The discussion of but one of the social and economic factors which affect the grazing industry is here proposed; i. e., our Government land policy [11].

There are two ways in which the tenure of the land must be considered, and they are here referred to as the "legal status" of the land and its "use control." Although ordinarily legal tenure gives use control, subject to the sovereign powers of the State and Federal Governments, the nature of the occupancy of some of these arid

lands does not permit full control of the use, for reasons already set forth [12].

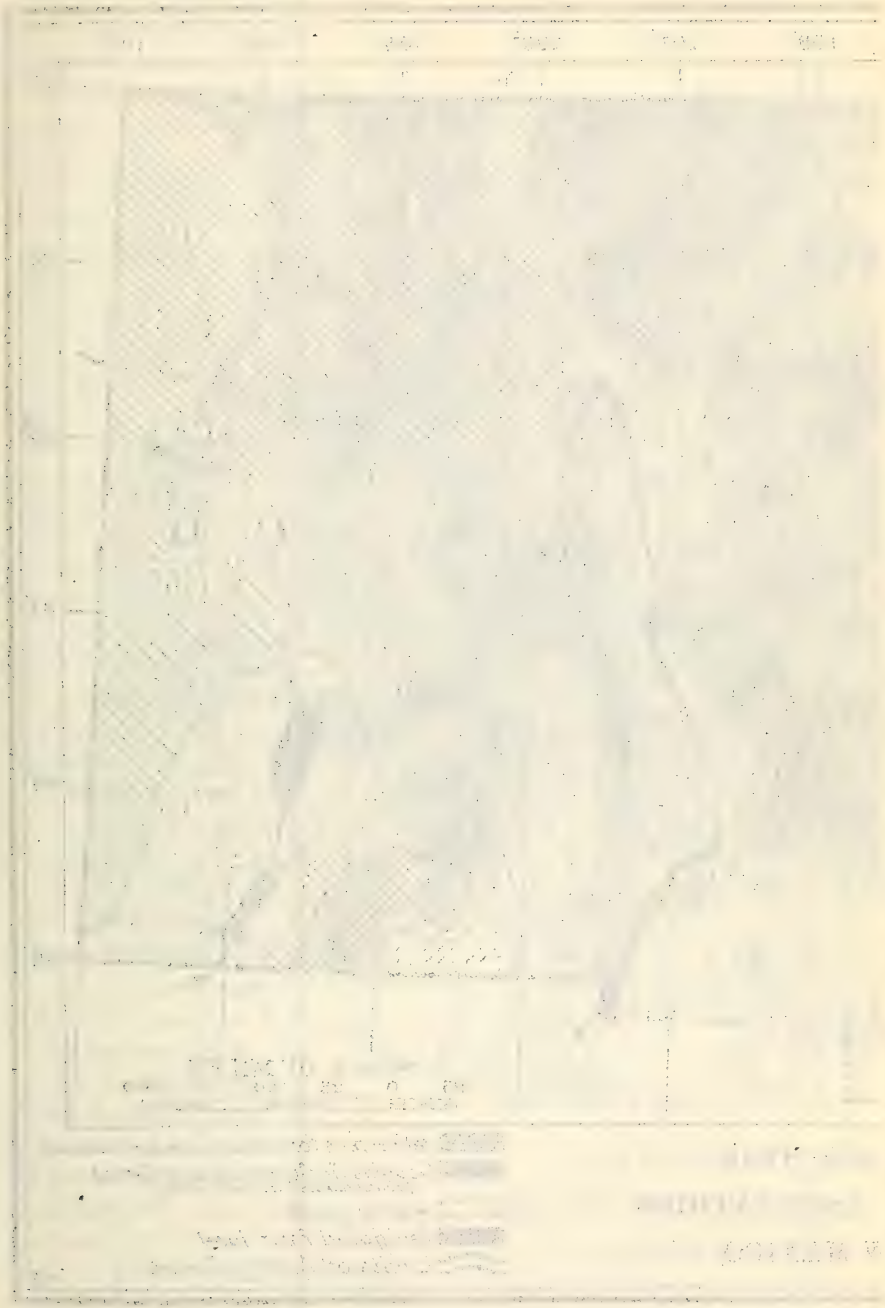
The legal status of the lands.—The present tenure of the land [2] is to be explained in terms of the history of its acquisition and the methods of disposal which have been in use by our Government [5]. The acquisition concerns us little here, but the methods of disposal explain very clearly the reasons for the present status. (See bibliography, section 1.)

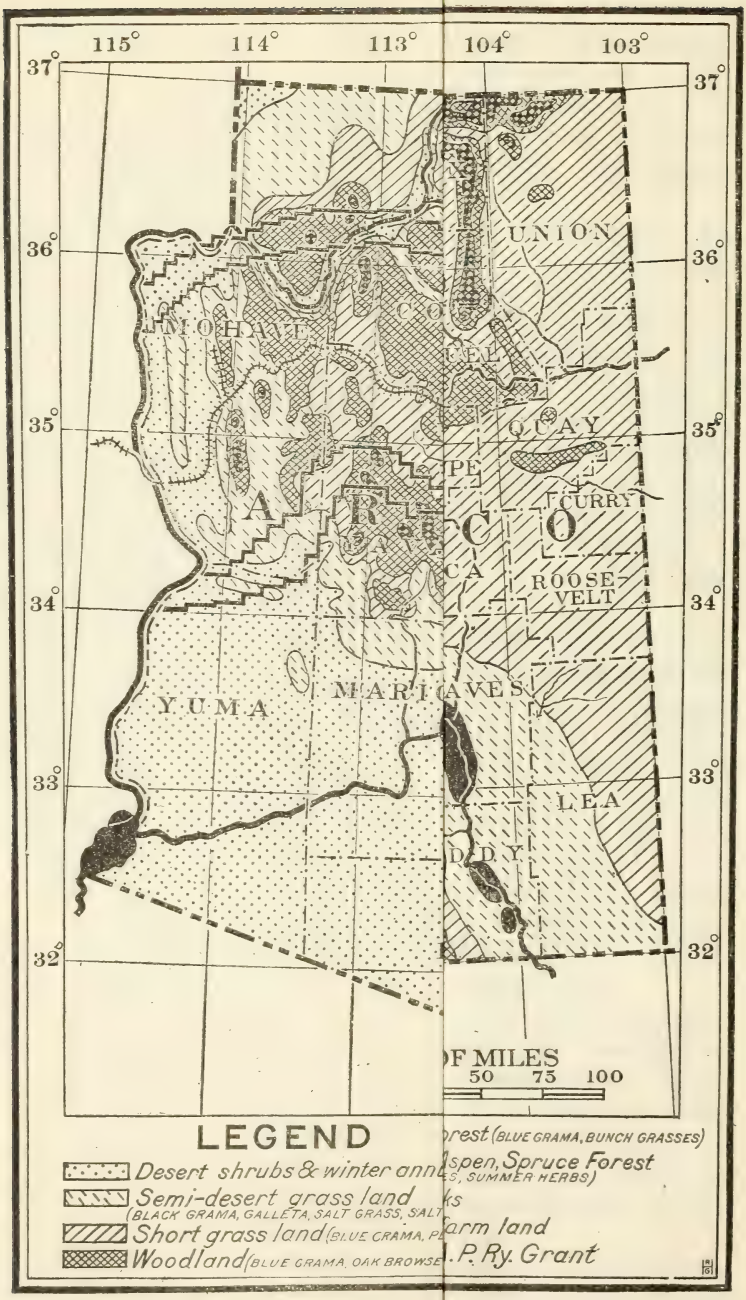
Large areas of land in certain of the Southwestern States that were originally settled by colonists from Mexico are held under titles conferred by the Government of the United States in accordance with treaty stipulations. In consequence there are to be found in this region many large areas of land lying in solid bodies, often amounting to many thousands of acres, that may be handled as units. Most of such land has been used as open range and much of it is still so used because the title rests in communities or groups of numerous heirs. Certain individuals, often part owners of the land, recognizing the advantages to be gained by proper management, have recently obtained control, in one way or another, of several of these grants and have fenced them. It is only a question of time until they will all be so managed. (See fig. 3.)

Immense areas of the land of the Western States have been set aside as reservations for the use of various Indian tribes under the direction of the Department of the Interior. (See fig. 4.) Changes in the areas of these reservations occasionally occur; sometimes they are extensions, but more frequently reductions, or the land may be allotted to individual members of the tribe. Extensions of area have led to the issuance of lieu land scrip for certain lands that have been surrendered for addition to the reservations (See p. 65.) Some of the Indians do not live on their reservations, or do not have enough stock to use all the forage. Under such conditions the Indian agents have rented grazing land or privileges to stockmen of the region—a practice which benefits both the stockmen and the Indians.

As early as 1823, Congress established the policy of granting areas of public lands to separate States and Territories to encourage the construction of canals, river improvements, and wagon roads. Beginning about 1850, grants of a similar character were made, first to the States, and later to the railroads, through certain thinly populated sections of the West. This policy was continued until 1871, and many millions of acres of public land were transferred in this way to railroad corporations [6]. (See p. 65.)

The ordinary method of making these grants was to give certain sections out of every township (usually the odd-numbered ones) within a belt of a specified number of miles on each side of the rail-





60835°—22. (To face page 17)

road, with an "indemnity" strip of specified width outside of this, from which selections could be made equal to the area of land already appropriated within the grant strip which would have come to the grantee under the terms of the act. (See fig. 2.) These lands were selected according to the terms of the act, but not all have yet been patented. On unsurveyed land it is impossible to issue patent and much of the land selected is unsurveyed at present. Considerable areas of land originally granted were forfeited to the Government because of failure to carry out the conditions of the grant. (See p. 65.)

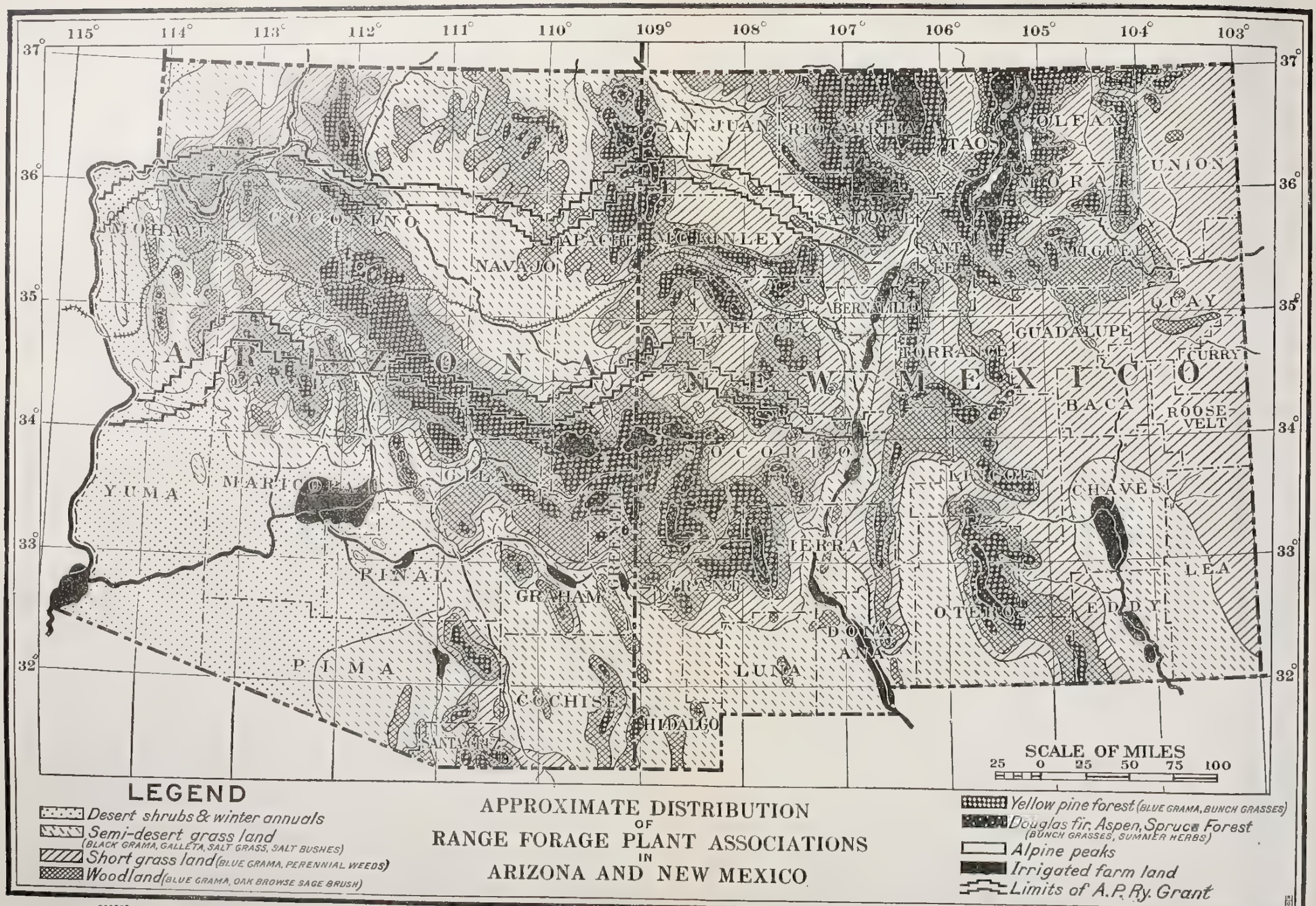
The original grantees have handled their lands in various ways. Much of such land has been sold outright to all sorts of purchasers, e. g., other railroads, land companies, lumber companies, stockmen, etc. Considerable areas are still the property of the railroads and are leased to various kinds of users. The right transferred by the railroad company is only that which they shall themselves receive after all Government proceedings relating thereto are complete. Under certain conditions parts of these lands have been returned to the Federal Government, and lieu land scrip, which may be placed upon other Government land that is open for entry, has been issued in exchange for it [7]. (See p. 65.)

The effect of the railroad land-grant legislation is to produce a checker-board arrangement of the land tenure in each township, the odd-numbered sections belonging, either tentatively (pending survey) or actually (patent having issued), to the railroad company or its assigns, and the even-numbered sections belonging to some other owner or to the National Government (see figs. 3, 4, and 5).

Certain sections out of each township, particularly in the West, were given at one time or another to a number of the States. These lands are managed by the States for the benefit of their public schools, and are usually referred to as State school lands. In New Mexico and Arizona, sections 16, 36, 2, and 32 are the school sections, unless they were appropriated before the laws granting them were made, under which circumstances the State received the right to make lieu selections (see figs. 3, 4, and 5).

At various times, under one act or another, relatively large grants of public land have been made to the different States, the proceeds from the lease or sale of which are used for the support of the higher educational and other institutions of the State. The administration of these lands and the school lands is usually in charge of a State land commissioner under laws passed by the State legislatures, and the policies are different in different States. In general, it is possible to lease any of such lands for longer or shorter periods, and some of them may be bought outright[11] (see figs. 3, 4, and 5).

[11] For details see the annual reports of the State land commissioners of the different States.



APPROXIMATE DISTRIBUTION OF RANGE FORAGE PLANT ASSOCIATIONS IN ARIZONA AND NEW MEXICO

60835°—22. (To face page 17)

FIG. 2.—For detailed explanation of this map see pages 13 to 15.

Beginning in 1891 there was inaugurated the policy of setting aside forested lands which ultimately became what are now called National Forests. The areas so withdrawn have been increased until now they amount to over 150 million acres. The use of these lands as a source of timber and timber products is of primary importance; of next importance is the proper control of watersheds so as to utilize irrigation and other waters in the best way; the control of the grazing within the forest ordinarily receives consideration after provision has been made for the other two uses. From the beginning down to the present the control of the grazing privileges in these National Forests has been one of the most difficult problems. Its solution has resulted in a system of permits to graze stock on specified areas for longer or shorter periods upon payment of certain fees, the granting of the permits being dependent upon various degrees of equity among applicants [87]. This system of control has been very beneficial to the forage crop within the controlled areas and consequently to the business affected thereby. It is generally referred to as the permit system of grazing control and it has certain advantages over other systems that have been tried, though, like every other system, it has disadvantages under certain conditions.

Private holdings of large size lying within the national forests, especially those like the railroad land grant sections, are to a considerable extent administered by the forest officials, under agreement between the owners and the Forest Service, with a pro rata division of benefits received. Exchanges for the purpose of consolidating the forested lands have occurred to some extent under various special acts authorizing this practice, which, although it has not always worked out satisfactorily, is of unquestionable value in certain selected places and under proper restriction. (See p. 65.)

Besides the national forests, certain other areas have been set aside as national monuments, national parks, military and naval reservations, etc., but the amount of such lands is relatively very small.

The recognized methods by which land may pass from the Government to a private individual are sale and homesteading [1]. Only very small areas may be sold to one buyer. Any of the surveyed, unreserved, unappropriated, non-mineral public land, may be taken under the homestead laws in certain limited quantities by anyone legally qualified to make homestead entry [3]. (See p. 65.)

The original homestead law (passed in 1862) allows an entryman to secure title to 160 acres. The great bulk of the good agricultural land was homesteaded under this law half a century ago. Practically all of the land that has been homesteaded within the last 15 or 20 years, until quite recently, is either dry farming land or land for which irrigation water has been found.

The enlarged Homestead Act was passed in 1909, allowing an entryman to obtain 320 acres of a certain kind of land as a homestead. Much of the land that was originally taken under this law was ultimately abandoned because it was too dry for dry farming; some of the holdings that were patented have been consolidated into larger blocks and are now mostly used as grazing land, small areas being cropped wherever and whenever practicable.

The Kinkaid Act, increasing the area obtainable in certain parts of Nebraska to 640 acreas, has been used in much the same way.

In December, 1916, the grazing homestead act was passed, allowing an entryman to take up 640 acres of land that is principally valuable for grazing. In its interpretations of this law, the land classification division of the United States Geological Survey, which has charge of the classification of the lands to which this law might be applied, recognized certain upper and lower limits of productivity of the land that might be taken under this act. Recent decisions have established a still lower limit of productivity which shall be recognized as the minimum production of land of this class. Much of the remaining land that is open for entry has already been classified as belonging to the class which may be obtained under the enlarged homestead act. Land which may be taken under the grazing homestead act is usually not classified until an application is made for a specified area, and the "application" is not allowed as an "entry" until a favorable classification is reported. The settler acquires no right to the land by going on it before his "entry" is recorded at the district land office. Since the entryman on an enlarged homestead may ask for an increase of his holding from 320 acres to 640 acres under the grazing homestead act, it is now customary to "enter" an enlarged homestead and "apply for" an additional 320 acres as a grazing homestead. This permits the settler to commence work on the place without loss of time.

The Kinkaid, the enlarged homestead, and the grazing homestead acts have all been passed in an attempt to provide proper land legislation for the dry lands of the West. Mostly, however, their effect has been to put land out of use for a longer or shorter time, because the areas obtainable under each act were not large enough for the profitable pursuit of the business which could be carried on upon the lands that were still available when the laws were passed. (See "Discussion of consequences," p. 49 et seq.) Notwithstanding what must be said against the working out of the policy which these laws represent, two minor advantageous results must be recognized. Legal tenure to the land is ultimately obtained locally, generally after much waste of labor and wealth; and the forage plants have an opportunity to recover from the effects of previous overstocking. The 320-acre law did help out some men who took up dry farming

land under the 160-acre law and were able to live on it, as did the Kinkaid Act in Nebraska. The grazing homestead act will help an occasional man to consolidate other holdings and make a productive stock ranch.

Under certain conditions an Indian who has not abandoned tribal relations may acquire a tract of land in lieu of his rights to common lands in an Indian reservation, under conditions similar to those of the homestead acts [3] except that the period of occupancy is longer before patent is obtained. Such areas are spoken of as Indian allotments. (See p. 65.) Like the homestead laws, this arrangement is not an unmixed blessing.

Thus the land of the arid grazing region is held as Mexican land grants; Indian reservations; railroad lands patented, lands selected but not patented, or lands the railroad titles to which have been sold to others; State school and institutional lands; national forests, monuments, or reserves; homesteads patented or pending; Indian allotments completed or pending; and Government land open for entry. It is possible, in one way or another, for the stock man to obtain legal control over the use of all of these lands except the Government land that is open for entry. The consequence of the application of these various laws is that the Government land is now so distributed that it is very difficult to find areas of controllable land of more than a very few sections in solid blocks, and that such blocks are usually so irregular in shape that the expense of fencing them is frequently prohibitive, even where watering places happen to be properly located to serve them. All these lands, except Government lands, have some kind of legal status that permits them to be fenced, if, by so doing, public lands be not enclosed. If the fencing of the privately owned lands would in any way interfere with the possibility of any citizen's using the public lands, the fencing must be arranged so as to avoid this difficulty, and frequently it is impossible to do this.

The outstanding feature of the case is that the laws governing the disposal of our public lands, because they do not authorize control of lands that remain in the hands of the Government, automatically prevent owners, lessees, and permittees who have invested large sums of money in their holdings and equities from fencing their holdings or otherwise controlling them in the interest of a more advantageous use. Nor is this all. The consequences to the State and to the nation are, (1) a much lower total production from the whole area, (2) a much lower standard of business organization than is easily possible and highly desirable, (3) a continually diminishing productivity of the lands, and (4) an increasing precariousness in the business, to say nothing of lost taxation and lack of social progress.

The diagrammatic maps (figs. 3, 4, and 5) will give some conception of the complicated condition of tenure that has resulted from the application of these land laws to a particular region. These maps, and the immediately following discussion of the present legal tenure of the land in the Atlantic and Pacific land grant area, are based on data taken from the previously cited report on the condition of grazing land in that area.

In studying the effects of the 1917–18 drought upon the stock-raising industry in Arizona and New Mexico, the present condition of legal tenure of the land of a selected area (the Atlantic and Pacific Railroad Land Grant) was ascertained from the District United States and State Land Offices at Santa Fe, N. Mex., and Phoenix, Ariz. These data were mapped on a large-sized base map and reduced copies of three sections of it are here presented.[12]

In studying these maps it must be remembered that much of the land shown as railroad land has been sold to others, sometimes to large companies who have sold again or now lease it. In a few places large consolidated areas of railroad land are shown. Such places indicate where railroad lieu lands have been selected in such a way as to consolidate an area so that it may be fenced up. In places alternating railroad sections are shown in the national forests. These lands may still belong to the railroad or may have been sold. In many cases they are administered by the United States Forest Service and the owner or lessee gets free permit for the number of animals such an area is able to carry.

Some of the land that lies inside the National Forests, but shown on the map as homestead land, is almost certainly railroad grant land which has been bought by its present owners. In Table 3 such land has been included with the homesteaded land, thereby raising the figures for percentage and total amount of homesteaded land, perhaps considerably above the actual.

Large areas are shown as Indian reservations and Indian allotments. The Navajos, Hopis, Zunis, and the remaining Pueblo tribes live on their reservations, but the Hualapais mostly do not stay on their reservations and the grazing privileges on about two-thirds of it are rented to stockmen.

The State school lands are restricted by law to certain sections in each township or lieu selections when these sections have been disposed of, but the other State lands have frequently been used to consolidate "checkerboard" holdings obtained from the railroad. Any of the State lands can be leased and some of them can be purchased. The government land that is open for entry is shown as white on the maps. The percentage of each kind of tenure within the land-grant strip is shown for each State and for the two States combined, in the table.

The maps and figures show clearly that the stockman's inability to control about one-fourth of the total area within the limits of this land grant determines how a large part of the remainder must be used.

[12] The condition shown in the maps is about as complex as any that can be found. The checkerboard arrangement of holdings is, of course, the result of the method used in making the land grant to the railroad company and is to be found only in regions where such grants were made.

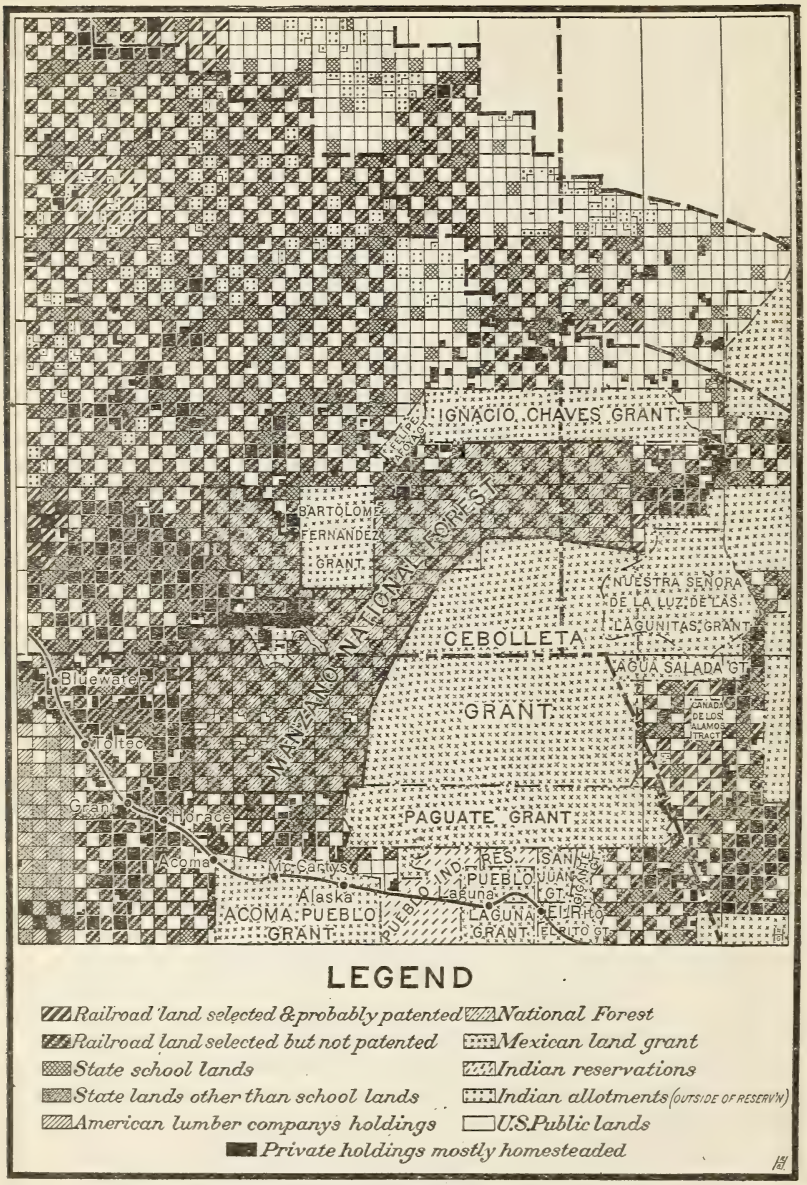


FIG. 3.—Diagrammatic tenure map of an area in northwestern New Mexico.

This portion of the tenure map shows:

1. The characteristics of the Spanish land grants.
2. The effects of a checkerboard arrangement of national forest and railroad grant lands.
3. The effects of the sale of railroad lands to private individuals (black) or corporations (American Lumber Co. holdings).
4. The effect of surrender of railroad lands for lieu land scrip, as shown in the white areas within the primary and secondary grant limits at the upper right-hand corner.

The distribution of the public lands, open for entry, is characteristic for any railroad land-grant area where the land is of low productivity.

Each of the small squares into which the map is divided represents one section of approximately 640 acres.

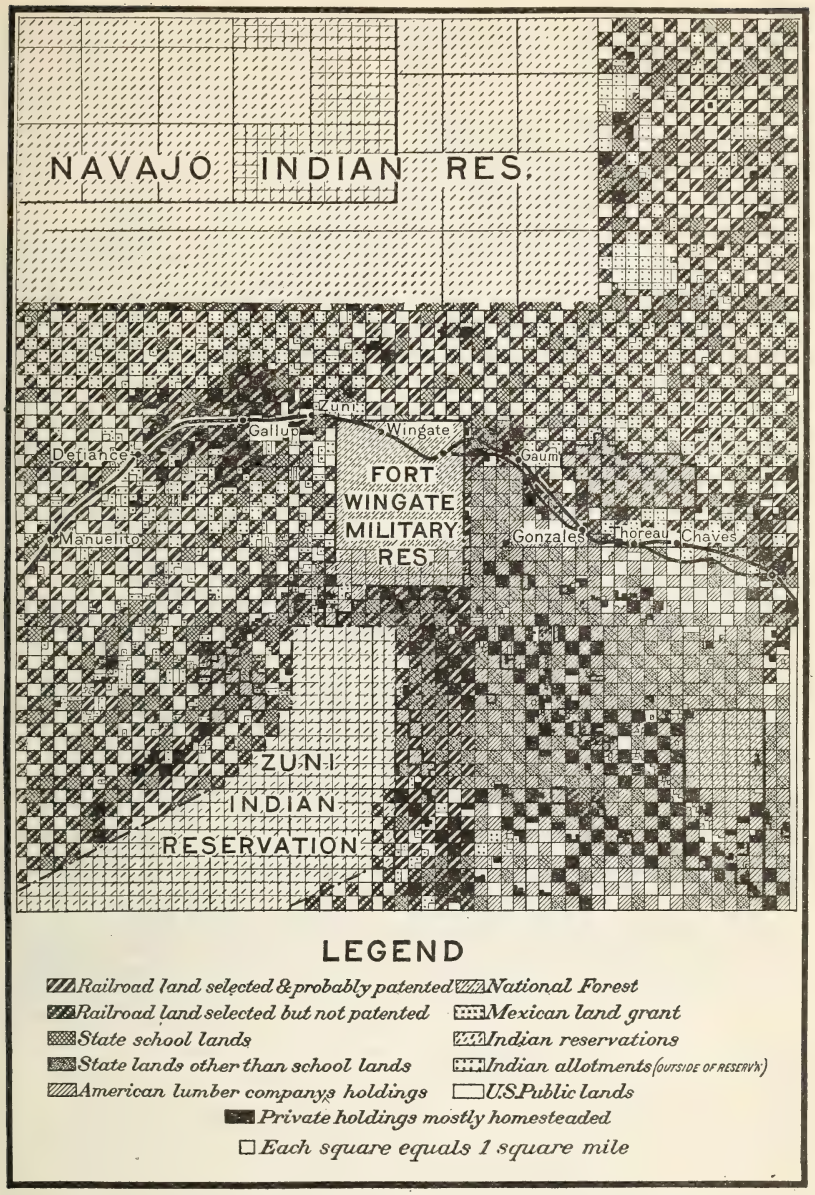


FIG. 4.—Diagrammatic tenure map of an area in northwestern New Mexico.

This portion of the tenure map shows:

1. The characteristic distribution of Indian reservations.
2. The area and distribution of Indian allotments.
3. The effects of the purchase of railroad lands by private individuals and corporations and the selection of the even-numbered sections by the State.

In much of the area the Government land (white) is shown to be that which determines the character of control possible.

Each of the small squares into which the map is divided represents one section of approximately 640 acres.

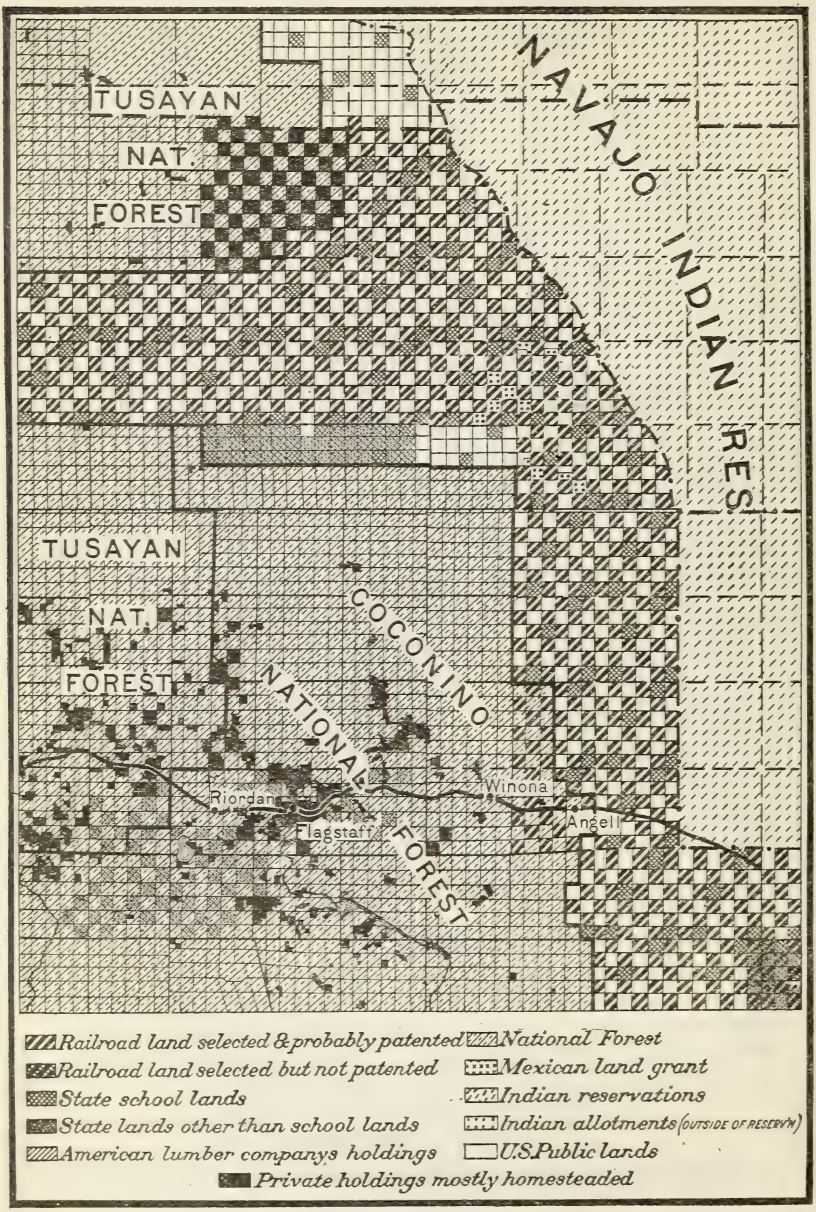


FIG. 5.—Diagrammatic tenure map of an area in central northern Arizona.

This portion of the tenure map shows:

1. Characteristic distribution of agricultural land in a national forest.
2. The effects of the purchase of railroad land inside national forest boundaries.
3. The results of State selections within national forest boundaries.
4. Consolidation obtained by State selections.
5. The typical checkerboard arrangement of railroad lands, State school lands, and Government lands.

Each of the small squares into which the map is divided represents one section of approximately 640 acres.

TABLE 3.—*Approximate subdivision of the lands within the Atlantic and Pacific land-grant boundaries.*

(According to tenure for each State and for the entire grant.)

	Arizona.			New Mexico.			Whole grant.	
	Area.	Percentage of area.		Area.	Percentage of area.		Area.	Percentage of whole grant.
		In State.	In grant.		In State.	In grant.		
Railroad lands:	*Acres.*			*Acres.*			*Acres.*	
Selected and patented	2,321,320	10.3	7.3	2,137,200	23.1	6.7	4,458,520	14.0
Selected, not patented	2,593,620	11.5	8.2	542,550	5.9	1.7	3,138,080	9.9
State school lands	1,478,320	6.6	4.6	523,520	5.7	1.6	2,001,840	6.2
State lands, all other kinds	935,280	4.1	2.9	140,280	1.5	.4	1,075,960	3.3
National forests	3,291,960	14.6	10.4	482,200	5.2	1.5	3,774,160	11.9
American Lumber Co. (originally railroad lands)				254,600	2.7	.2	254,600	.8
Indian reservations	4,532,480	20.1	14.3	1,458,200	15.8	4.6	5,990,480	18.9
Indian allotments (outside reservations)	129,840	.6	.4	338,640	3.7	1.1	468,480	1.5
Mexican land grants	92,640	.4	.3	952,040	10.3	3.0	1,044,630	3.3
Private holdings (mostly homesteads)	952,120	4.2	3.0	448,320	4.8	1.4	1,400,440	4.4
U.S. Government lands	6,221,120	27.6	19.6	1,966,240	21.3	6.2	8,187,360	35.8
Total	22,550,600	100.0	71.0	9,243,800	100.0	29.0	31,794,400	100.0

NOTE.—The figures given here are only approximations. Much of the land has not yet been surveyed and exact figures could not be obtained. The estimate in acreages assumes all sections to contain 640 acres, which, of course, is not exact. The percentages of the different kinds of tenure are doubtless fairly accurate, at least to units place.

The present use-control of the land.—The problem of how to control the range in separate units of such size as to make the business of raising stock profitable has been before all stockmen ever since the ranges commenced to be crowded, even in local areas. In earlier days there was an abundance of feed for the animals of those who had the courage and skill to enter the business, but in a relatively short time the excess feed was all used in the more favorably located places, and the contest for place began.

The necessity for individual control has kept pace with the growing specialization of the business, and rising prices have made profitable greater and greater expenditures for rights or privileges in a range. The struggle has gone on from one degree of intensity to another until at present many individuals and firms have invested large sums of money in permanent improvements, such as wells, reservoirs, pipe lines, troughs, corrals, fences, houses, etc., as well as in the purchase or lease of part of the lands they are using. Whenever it has been possible, such men have got legal control of all their land and fenced it. In practically all cases the improvements have been protected by some sort of legal control of the land on which they have been made. A few men make their investments as small as possible with the object of making some one else bear their burden of capitalization, and thus take advantage of the open range condition.

The existing system of management in this industry is determined in many cases by the possible use which may be made of Government land and the legal control of the land upon which stock water occurs.

Ordinarily the land carrying the water is owned by the user, though he may lease it from a railroad company, from the State, an Indian reservation, or other owner. Ownership has sometimes been obtained by homesteading, sometimes by placing lieu land scrip on it. Sometimes the water is covered by a patented mining claim, or, if it is on unsurveyed land, rights may be acquired by a settlement made by a qualified homesteader for the purpose of subsequently making homestead entry after the lands are surveyed, and such rights can be maintained only by substantially continuous occupation and the right to all improvements which he may make or purchase from a former occupant. Sometimes the water is on a mining claim that is not patented, but tenure of the claim is maintained by doing the ordinary assessment work each year.[13]

To-day the open range is held on a tacit agreement among stockmen that the stock water will be used in common, each man developing enough for the number of animals he puts on the range. The feed also must be used in common, since each ranch is bounded only by the imaginary line passing halfway between its watering places and those of the nearest neighbors all around it. Thus feed and water, salt and bulls, must be used in common, and individual control of their businesses is not possible for most of the stockmen of the region.

Notwithstanding the undesirable and irritating conditions that surround the industry, the old policy of "eat out the range and move on" has been discarded forever. The men who now carry on the industry are as permanently located as men in other kinds of business and are anxious to develop it as rapidly as possible if the opportunity is given them. That opportunity can be given only by proper land legislation.

As an indication of what men will do to get control of the ranges they use, some data as to the use-control of the lands inside the Atlantic and Pacific land-grant area are presented.

In the study of grazing lands previously referred to, some data were obtained relative to the actual control of the lands of the region examined.[14] The lands originally granted to the Atlantic & Pacific Railroad Co. have been sold or leased to many companies and individuals. The existing use-control of the region is very largely determined by the present legal tenure of these lands, though the disposition of the State lands of the area is also an important factor. Stockmen have bought or leased large areas of this land in the hope of controlling as nearly as may be all the land they use. A few of the holdings are completely consolidated, under one form of tenure or another, and are partly or all fenced.

The sizes of the range units shown in Table 4 are approximately the amounts of land that individual stockmen use (occasionally in common with others who have little or no equities) by virtue of having bought or leased most or all of the lands of their ranges that could be so obtained. The proportion of each range so held varies from more than half to all of it.

[13] The minimum amount of development work on the claim required by law to maintain possession.

[14] This information was obtained through the courtesy of the officials of the Santa Fe Railroad Co., St. Louis & San Francisco Railroad Co., Aztec Land and Cattle Co., and numerous individuals.

TABLE 4.—*Number of ranges of indicated sizes and total areas (approximate) which are individually used and to some degree controlled by virtue of equities in that part of each range that may be obtained by purchase or lease from the railroad or other owner.*

Approximate size of area used (acres).	Arizona.		New Mexico.		Total.	
	Number.	Total area so controlled.	Number.	Total area so controlled.	Number.	Area so controlled.
		Acres.		*Acres.*		*Acres.*
10,000 or less	43	126,720	23	121,600	66	248,320
10,001 to 20,000	45	637,200	41	599,040	86	1,236,240
20,001 to 40,000	71	1,748,480	77	1,997,480	148	3,745,960
40,001 to 60,000	28	1,292,160	13	608,640	41	1,900,800
60,001 to 80,000	7	496,000	9	610,560	16	1,106,560
80,001 to 100,000	7	614,400	7	646,400	14	1,260,800
100,001 to 150,000	16	1,872,000	3	368,640	19	2,240,640
150,001 to 200,000	7	1,154,560	4	652,800	11	1,807,360
200,001 to 300,000	2	496,000	.....	.....	2	496,000
300,001 to 400,000	2	693,120	.....	.....	2	693,120
Over 400,000	.....	.....	[a]1	587,520	[a]1	587,520
Total	228	9,130,640	178	6,192,680	406	15,323,320
Average size	.....	40,047	.....	34,790	.....	37,742

[a] This area is subleased to a number of small operators.

TABLE 5.—*Data obtained from stockmen using ranges within the limits of the Atlantic & Pacific Railroad land grant [12].*

Item.	Cattlemen.		Sheepmen.	
	Average number of acres.	Number of men reporting.	Average number of acres.	Number of men reporting.
Character of tenure:				
Leased railroad lands	23,752	35	23,441	20
Leased school lands	5,409	43	3,444	19
Leased State lands	7,146	24	29,257	7
Owned lands	6,635	39	18,305	21
Approximate size of area used	74,286	62	[a]73,220	32
	Average number of years.	Number reporting.	Average number of years.	Number reporting.
Period of use	14.4	39	10.3	15
	Average acres per cow.	Number reporting.	Average acres per sheep.	Number reporting.
Estimate of grazing capacity:				
Normal	38	50	11	15
Decrease due to use (estimated average)	5 per cent.	42	5 per cent.	20
Decrease due to current drought (estimated average)	30 per cent.	46	36 per cent.	23

	Cattlemen.			Sheepmen.		
	Total number.	Average number per ranch.	Number reporting.	Total number.	Average number per ranch.	Number reporting.
Number and kinds of watering places:						
Springs	175	6.2	28	18	2.5	8
Streams	10	1.6	6	.....	.....	.....
Reservoirs or tanks	209	6.5	32	133	7.0	19
Wells	87	2.8	30	32	3.5	9

[a] Two very large holdings omitted because definite data were not obtainable.

The table also indicates that the stock ranches of the region mostly contain from one-half to two townships of land, which is probably a fair indication of what stockmen of that region think they need. (See also Table 5.)

SOME CONSEQUENCES OF THE OPEN-RANGE METHOD OF STOCK RAISING.

An open-range system of management of the arid grazing lands of the West has been inevitable, in view of the natural conditions of the region and the Government land policy which has been followed. Only in a few localities has it been possible to avoid this system and its consequences.

Compulsory overstocking.—The most far-reaching effect of the open-range system is that it compels men to overstock their ranges all the time. A properly adjusted system of land tenure would tend to the automatic removal of the evils which arise from this practice. With laws as they are, possession of any unfenced grazing range containing Government land is to-day held by occupancy only. If a stockman removes some of his stock because he knows there is insufficient feed on the range to supply all the animals till the next growing season, he thereby merely invites some one else to bring stock in and take the feed that has been saved. By this process he loses part of his range and does not avoid the loss of stock that will come later. Yet all stockmen who have large investments and are permanently located in the open-range country recognize these losses as one of the undesirable features of the business and charge up such recurrent losses as a part of the expense of running such a business.

The results of continued overgrazing, in order of occurrence, are (1) reduction of the quantity of the most palatable feed, (2) extermination of the best forage and its replacement by inferior kinds, and (3) continuance of this process till all edible plants are gone and the ground is bare or covered only with unpalatable weeds. Reduction in the number of plants increases erosive effects and hastens the later stages of denudation. The final stage is often bare rock or gravelly arroyo.

On an overgrazed range there is never much, if any, reserve feed, so that whenever a drought occurs the stock must be taken off very soon or in a short time they begin to show signs of insufficient feed. Such forced removals are nearly always undesirable, because prices are likely to fall when there is no alternative but to throw large numbers of animals on the market. With the rainfall as uncertain as it is in the arid grazing region, a system of management which does not provide for a supply of feed sufficient to carry the stock over at least one season of below-normal production is very undesirable. Yet an open-range system of management makes this necessary conservation of range feed practically impossible.

Premature grazing.—On an open range it is the common practice to turn the stock onto patches of young growing feed before the plants have had time to do more than get well started. If one

rancher does not do it, somebody else will; so each must do what he knows to be unwise or suffer a greater loss. This practice prevents the production of seed, hastens the extinction of the best plants, and reduces the total quantity of feed produced on the range that season. Experimental measurements of the amount of dry matter produced by certain cultivated forage plants that were cropped back every week showed that they produced less than one-third as much as similar plants that grew to maturity before being harvested.[15] While this estimate of 30 per cent does not of necessity apply to range forage plants, there is little doubt that the percentage is approximately the same in their case. A fence, therefore, is just as necessary to keep stock off certain areas at times as it is to keep them from leaving an area.

Improper seasonal use of feed.—Frequently on part of a given range there is feed which is good only in the summer and which must be used at that time in order to make the most of it. On another part of the range is feed which may be used both winter and summer, but the stock prefer it at any time to the summer feed. If the stock are sheep, the herder can hold them on the summer feed in the summer time; but if they are cattle they will eat the winter feed in the summer time, allowing the other to be wasted. It is impossible to control cattle on such a range unless the summer feed can be fenced and the cattle held upon it until they get hungry. Once having commenced to eat it they usually do well upon it.

This condition may be reversed as to season. Feed that is available only at a particular time of the year can not be utilized at all unless taken at that time. Stock always eat first what they like best, even though the later consequence of such a practice is starvation.

On certain areas there is a crop of feed available only for a short season. A striking example of this is the abundant and excellent feed on the upper slopes of the high mountains in the middle of the summer. But stock can not stay in these localities during the winter because of the temperature and the lack of feed. Therefore, in order that such feed may be utilized, it is necessary that it be eaten by stock that can come to the region during the summer and go elsewhere during the winter. In other words, it is summer range and must be associated with some winter range in order that it may be used at all.

If winter range of proper grazing capacity is within driving distance for sheep, as it is in certain places in Wyoming and Utah, the conditions necessary for the utilization of the feed are supplied for those who can get control of both kinds of range, provided there is a passageway between with sufficient feed for the stock in transit. If

[15] See Farmers' Bulletin 228, 1915.

the only available range that may be used as winter range is really yearlong range and cattlemen establish themselves thereon and use it that way, or if cattlemen permanently occupy the yearlong range that nearly always lies between the summer and winter range, what becomes of the summer feed which cattle can not go after?

The condition may be reversed. Cattlemen sometimes take their stock up into the mountain forests in the summer and bring them down onto the open, nearby plains in the winter—a common practice in parts of Arizona. Suppose that bands of sheep have grazed over these plains (which are yearlong range) during the summer, and have eaten all the feed. What can the cattlemen do? And again, what becomes of the summer feed in the mountains if the cattle must stay on the plains all the time to maintain possession?

The answer to the question rests in no way upon the kind of business that may be established in the region. Each has its advantages and its limitations. It is just as necessary that we produce mutton and wool as that we should have beef and leather. In many places either business can be maintained and in places where the control of the range has been established long enough for the producers to try out various policies, as in California and Texas, many have found it profitable to run both kinds of stock on the same range [12].

The influence of unprogressive men.—A man who is lazy, or a bad manager, obstinate or quarrelsome, or merely lacks the capital for necessary improvements, is a continual source of irritation to his neighbors on an open range. He either can not or will not do the right thing for the group to which he belongs. He does not develop water where he should for his own stock, consequently they get more water from his neighbors' watering places than their stock get from his. He may be sincere in his belief that salting is not necessary and his neighbors must buy all the salt. He is too impecunious or "conservative" to buy good bulls, hence others are paying for the building up of the grade of his herd and he is doing all he can to keep the breed level down.

There is no way to get along with such a man except to put him where he and his business must suffer the consequences of such shortsightedness; i. e., on an inclosed range of his own. On an open range, such a man very nearly standardizes the grade of business that may be done by everybody, since his neighbors must carry him if they standardize above him. He profits at their expense because of his backwardness or stupidity.

Low rate of increase.—On a stock range the only source of income is the salable animals, the number of which is dependent upon the size of the breeding herd and the percentage of increase obtained.

Animals of breeding age which do not breed are an incumbrance to the business and should be disposed of at once. Moreover, gross receipts depend upon quality as well as numbers of the salable animals. High class results, therefore, are dependent on the degree of control over breeding.

On an open range there is little possibility of obtaining effective control over the breeding of cattle. The ultimate result of this condition is a small percentage of calves per hundred cows of breeding age. When the percentage of increase is small the range is carrying more aninals, both cows and bulls, than are necessary to produce the largest possible number of salable animals. If the percentage of increase is 35 (the estimated average for New Mexico in 1918) the range must carry about 4.5 mature animals for every one that is sold. If the percentage of increase is raised to 70 the ratio is 2.7 to 1, assuming the common type of business of that region, and the ordinary losses. On a controlled range it is not difficult to raise this percentage by the adoption of three or four practices that are easily applied when the pastures are fenced, but which are practically impossible otherwise. The rules of these practices are: (1) Use small breeding pastures; (2) wean the calves at six months, and keep them away from the cows; (3) feed small quantities of concentrates to the breeding animals of both sexes for a short time before and during the breeding season, and (4) keep all steers out of the breeding pastures. By such methods as these it is possible to control the time of dropping of calves and so have a uniform bunch of yearlings to show the buyer when he comes. Much better service can be obtained from valuable bulls in this way, and a larger number of calves from each bull, thus reducing the number of breeding animals necessary and increasing the possible output of salable animals. These practices result not only in a larger number of salable animals but in a higher price for them when sold. (See p. 38.)

Increased expenses.—Another way in which the lack of individual control reduces the net returns of the business is by compelling larger expenses. Open range management of a cattle ranch requires more men and saddle horses at work all the time than are necessary on a fenced range of the same size. An increase in the saddle horses needed makes necessary an increase in the stock horses (breeding mares) on the ranch, with a consequently smaller number of cows. Such an increase in men and saddle horses increases the payroll for labor and the expense for food and feed.

An open range necessitates the semiannual "round-up," which is always expensive, not very effective, and frequently comes at an inconvenient time. The round-up method brings a labor load for a short time that is sometimes very hard to carry. Even under the

best conditions the round-up work is hard on men, horses, and cattle; night guard work is altogether disagreeable, as are other round-up duties. Taken altogether, it is an undesirable practice. Experienced cattlemen who have used both open and fenced ranges all prefer the latter and agree that there is much less work on the fenced range and that the required work is easier. Stock handled in fenced pastures, especially if they are fed occasionally, are usually gentler than those that run on an open range. From the standpoint of the stockman, gentle stock are much more satisfactory to work with and they utilize the feed better than those that are wild and nervous. Open-range conditions tend to produce the latter condition while the fenced range has the opposite effect.

Losses.—The losses so far mentioned are indirect—the result of reduced production of feed, reduced output of salable animals, a lower standard of quality in the animals sold, and an increased expense of production, all of which make for a smaller net income than might reasonably be expected from the business.

The open-range system of management also causes direct losses. The most important of such losses are naturally those which result from starvation of stock during periods of drought.

In addition most ranges produce certain poisonous plants. On an overgrazed range these plants are generally more conspicuous and better grown than others that are good feed, because the stock will not eat them when other feed is obtainable. Hungry stock will eat the poisonous plants, and a certain percentage of them die in consequence.

Some animals "drift" from one watering place to another, causing considerable extra riding to bring them back and the loss of a few head.

A small number of animals are missed each year at the round-up work. Some of such animals should be sold off the range that season, either because they are in good condition for sale or because they are of too poor quality to warrant carrying over another season. Such stock when left on the range are a distinct loss to the business, since they eat feed that should be going to other animals.

Sick animals are hard to find, and many die that might be saved if they could be found in time. This condition is worse on an open range than in fenced pastures.

The custom of New Mexico and Arizona cattlemen is to figure on a 10 per cent loss on the open range. This figure is doubtless an average that includes the big losses from death during drought. Figures obtained from fenced ranges show average losses of from 2 to 3 per cent only. (See p. 38.) Since this percentage applies to the whole number of animals, the possible reduction of loss (7 to 8 per

cent) is alone almost enough to pay the interest on the capital invested in the animals themselves.

Difficulty of controlling disease.—The fence plays a dominating part in the control and eradication of contagious diseases. The quarantine is above all else the most effective measure against the spread of contagious diseases, but it can not readily be used on an open range. Much of the work of the United States Bureau of Animal Industry in the eradication of diseases that must now be handled indirectly could be much more easily managed if the ranges were divided into convenient-sized areas by fences. The spread of certain very dangerous contagious diseases, like foot-and-mouth disease, could be stopped on an open range only with the greatest difficulty, while on fenced areas an effective quarantine could be established as easily as in a farming district.

Unbranded range horses.—In certain regions bands of unbranded range horses are a source of irritation and loss. They are almost valueless to their owners, who fail to brand them in order that they may avoid taxation, yet no one else can put them out of the way without incurring an obligation to pay for them. These animals use and trample out much forage that might be used by meat animals.

Financial drawbacks.—The general precariousness of the business is much greater on the open range, and the degree of complexity of organization possible and the probability of plans being consummated is considerably less. Hence operating capital is more difficult to obtain because of the risk entailed, and the cost of such capital is greater. In the final analysis these difficulties all arise from the compulsory overstocking that can not be avoided on open ranges. The ultimate effect of an open range system of management is to standardize the business at the level of its lowest rather than its highest productivity.

Effects of drought.—At no time do the undesirable consequences of the open range method stand out so glaringly as during a period of drought. Yet such periods, varying in length from one or two to three or four years, occur at more or less regular intervals. They constitute one of the most important limitations of the range stock business, because the supply of feed produced upon the arid grazing lands is practically determined by the amount of water available to the plants during the growing season.

When a drought occurs the stockman must do one of three things: (1) Remove some of the stock from the range, (2) begin or increase feeding operations, or (3) let the stock die. These necessary practices suggest a means of estimating the effects of a drought, from data that give comparisons between results obtained during years of average rainfall and years of drought. The removal of stock

gives rise to increased shipments of stock as well as seasonal displacements of such shipments. Increase in feeding operations results in increased movements of concentrated feeds. Changes in percentages of loss of animals as well as changes in the rate of increase in the flocks and herds are also very suggestive. Reliable data and estimates on these points are available from several sources.

The following data, taken from the report heretofore mentioned, are illustrative, and give as accurate measurements as were to be had of the effects of one such drought:

The annual reports of Secretary T. D. Allen, of the New Mexico Cattle Sanitary Board, show that shipments for 1917 were 161.1 per cent of the average for the previous seven years, while the estimated calf crop for that year was 15 to 20 per cent below the normal average. For 1918 the shipments increased to 177.5 per cent and the rate of increase fell off 5 per cent more.

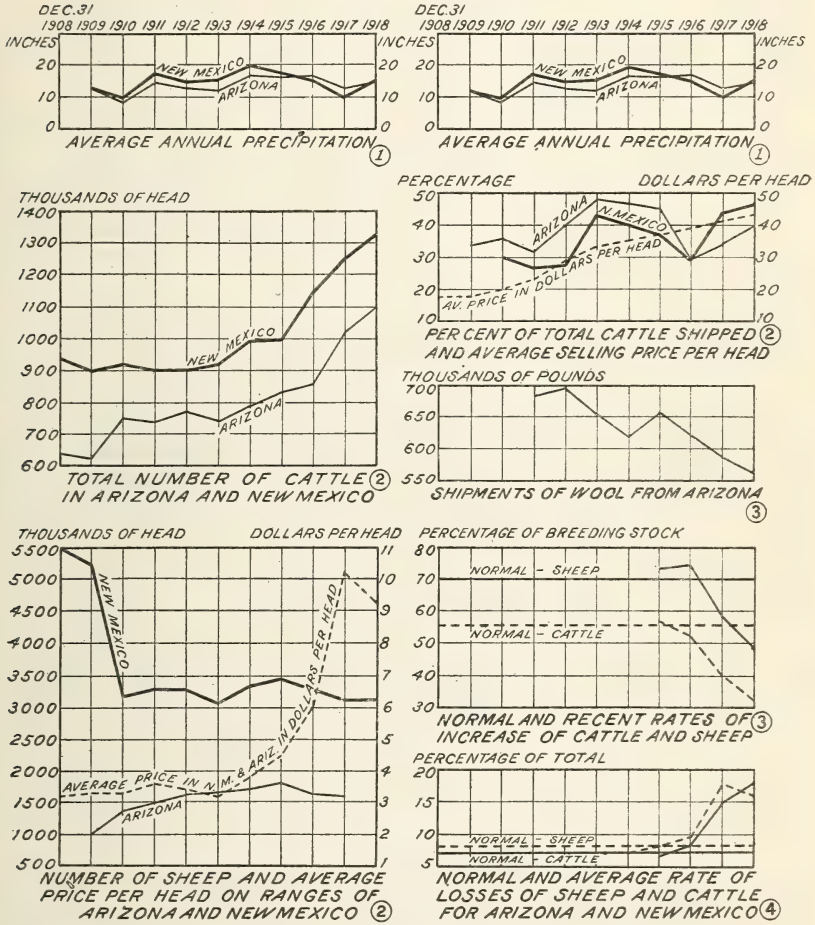
The records of Secretary Logan, of the Sheep Sanitary Board of New Mexico, tell much the same story, though not quite so conclusively. Shipments of sheep out of New Mexico were mostly restricted to stock sold, and the numbers fell off noticeably. The average shipments out of the State for 1914 and 1915 was over 1,100,000 head, and the shipments in (which are to be considered as purchases of breeding stock in normal years) was slightly less than 10 per cent of this amount. In 1916 (the year the drought began in Texas, but a year of average rainfall in New Mexico) shipments out of the State dropped to 885,000 and shipments in nearly tripled the normal expectation. In 1917 outgoing shipments fell still further (780,000) and incoming (mostly Texas stock) went up to 10 times the normal expectation. The 1918 shipments dropped to 615,000. Normally sheep shipments in this State occur between October 15 and December 15, but during 1918 they occurred throughout the year.

The normal lamb crop for the State is about 75 per cent of the number of ewes of breeding age. For 1917 the best estimate for the State was 45 per cent, while for 1918 it was 35 per cent. Actual figures as to losses were not obtainable, but they were probably large. It was the general belief that the lamb crop in the three southeastern counties of New Mexico would not replace the ewes that died.

Normally it has not been customary to feed concentrates to range stock in Arizona or New Mexico, though a few men feed small quantities to weaklings occasionally. No data as to total quantities of feed used during 1917–18 were obtainable in either of these States, but men who had never fed their stock before in their lives were feeding large quantities of concentrates and hay, although the prices of these feeds were two and one-half times the normal. Many men saved their stock by chopping soap weed or cactus at greatly increased expense for labor and machinery. (See bibliography, sec. 8.)

Individual records were obtained from 40 sheepmen and from 74 cattlemen who were grazing animals in the land-grant area. Various expressions of opinion, estimates and fact were obtained from them, some of which are shown in Table 6. (See also fig. 6.)

DIAGRAMS SHOWING RELATIONSHIP BETWEEN RAINFALL AND VARIOUS MEASURES OF THE STATUS OF STOCK RAISING IN ARIZONA AND NEW MEXICO


DEC.31
1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918
INCHES
NEW MEXICO
ARIZONA
AVERAGE ANNUAL PRECIPITATION (1)
AVERAGE ANNUAL PRECIPITATION (1)
THOUSANDS OF HEAD
NEW MEXICO
ARIZONA
TOTAL NUMBER OF CATTLE (2) IN ARIZONA AND NEW MEXICO
PERCENTAGE
DOLLARS PER HEAD
ARIZONA
N.MEXICO
AV. PRICE IN DOLLARS PER HEAD
PER CENT OF TOTAL CATTLE SHIPPED (2) AND AVERAGE SELLING PRICE PER HEAD
THOUSANDS OF POUNDS
SHIPMENTS OF WOOL FROM ARIZONA (3)
THOUSANDS OF HEAD
DOLLARS PER HEAD
NEW MEXICO
AVERAGE PRICE IN N.M. & ARIZ. IN DOLLARS PER HEAD
ARIZONA
NUMBER OF SHEEP AND AVERAGE PRICE PER HEAD ON RANGES OF ARIZONA AND NEW MEXICO (2)
PERCENTAGE OF BREEDING STOCK
NORMAL - SHEEP
NORMAL - CATTLE
NORMAL AND RECENT RATES OF INCREASE OF CATTLE AND SHEEP (3)
PERCENTAGE OF TOTAL
NORMAL - SHEEP
NORMAL - CATTLE
NORMAL AND AVERAGE RATE OF LOSSES OF SHEEP AND CATTLE FOR ARIZONA AND NEW MEXICO (4)

(1) COMPILED FROM U.S. WEATHER BUREAU REPORTS
(2) COMPILED FROM YEAR BOOK U.S. DEPT. OF AGRICULTURE
(3) DATA FURNISHED BY FEDERAL CROP REPORTER
(4) COMPILED FROM ALL INFORMATION AVAILABLE

FIG. 6.—Effect of rainfall on the live-stock industry in Arizona and New Mexico.

TABLE 6.—*Data obtained from stockmen using ranges within the limits of the Atlantic and Pacific Railway land grant [12.]*

Data.	Cattlemen.		Sheepmen.	
	Average percentage.	Number reporting.	Average percentage.	Number reporting.
Estimates of losses:				
Normal	8	50	9	35
For 1917	16	23	20	10
For 1918	18	37	17	25
Forced reduction of breeding stock:				
In 1917	26	6	60	5
In 1918	16	36	67	7
Rate of increase: [a]				
In 1915	52	19	78	8
In 1916	49	27	76	12
In 1917	45	48	58	26
In 1918	34	58	48	32
Estimated normal	55	44	90	26
	Number who fed.	Number reporting.	Number who fed.	Number reporting.
Supplemental feeding:				
Ordinary practice—				
To feed none	18	42	12	17
To feed a few	6		2	
To feed poor, weak stock	18		[b] 3	
In 1917—				
Fed none		14		
Fed a few	5			
Fed a large number	9			
In 1918—				
Fed none	5	30		11
Fed a few	8		1	
Fed a large number	16		6	
Removed stock	1		4	

[a] Based on number of breeding animals. [b] Feed bucks.

SOME BENEFITS ARISING FROM FENCING THE RANGE AND CONTROLLING THE METHODS OF USE.

In contrast to the disadvantages of an open range are the positive advantages that may result from individual control. Experience on privately owned ranches of large size, as well as experimental results obtained where all the factors were known and measured, show that in many ways the business may be better organized, rendered more productive, and relieved of many of its uncertainties by simply giving the present user a legal right to control the land he now uses.

A change in our laws which makes it possible to grant to an individual, or a small group of individuals acting together, the privilege of grazing stock upon a specified portion of a National Forest, for a limited time and under definite regulations, has resulted in marked advantage to the users, even though the permit has only occasionally carried with it the privilege of fencing the land used. The establishment of a legal method whereby the arid grazing lands might be fenced in units of convenient size would revolutionize the business by removing the obstruction to its orderly development. Of course mere control of itself does not necessarily bring about the improved

organization and better managerial practices. The experience of the stockmen of western Texas during the recent drought demonstrates that it is easily possible to overstock fenced ranges. But fenced ranges render possible many improvements in organization and practice that are impossible on an open range, thus eliminating or at least minimizing the disadvantages previously discussed. (See bibliography, sec. 10.)

Increase in quantity and quality of feed.—Probably the first and most important effect of control would be a marked increase in the quantity of available forage. This has been the almost universal experience upon ranges that have been inclosed. (See bibliography, sec. 7.)

Besides the increase in the total amount of feed produced on the range, the fence also makes possible the maintenance or improvement of the quality of the range feed. All that is necessary to bring about this result is to allow the plants to go to seed at frequent intervals. Deferred grazing, as this practice is called, and rotation of pastures result in more feed and better feed [82], an assured supply of feed on the ground all the time, a reduced run-off, and the consequent better utilization of the water that falls.

It is upon such fundamentals as these that the prophesy of marked increase in production on controlled ranges rests, especially when taken together with an increase in the percentage of young produced. Such prophesies are not mere statements of theoretical possibilities; they have been convincingly fulfilled wherever the system has been carried out.

Introduction of valuable plants.—The improvement of the grazing capacity which may be expected to occur automatically upon a well managed controlled range is but the beginning of the total ultimate increase in feed which may be expected. There are numerous ways in which this increase may be brought about. Living now upon the ranges may be found certain kinds of plants that are better adapted to the environment than others, and which are at the same time better adapted to grazing uses. Individual plants of a given species possess variations that are economically valuable. Such plants, by proper treatment, may be made the dominant forage on a range, thereby considerably improving its grazing capacity. Shrubby plants of known value are very desirable on parts of the winter ranges, especially when such ranges are occasionally covered by heavy snow. There are forage plants which have not yet been tried out that will increase the forage output of much of such land. Little has been done toward such improvement of the range feed, and there is very little incentive for efforts of this kind, because as long as the stockmen have no control over the land which they use none of them can afford to make experiments.

Relatively little [16] is known of certain steps in the life histories of some of the best of our native forage plants, and almost nothing of what may be necessary in order to get more abundant reproduction of such plants. Some such experimental attempts have been made—mostly by planting seeds—but nearly all such efforts have given negative results. Some attempts at saving the run-off have proved partially successful, but they are rather expensive [74]. Further studies in these directions are amply warranted, especially with respect to the treatment to which seeds of certain valuable forage plants should be subjected in order to secure sure and rapid germination and growth.

Some results of experimentation.—Carefully conducted experiments on the Jornada Range Reserve in south central New Mexico, by the Forest Service, in cooperation with an experienced stockman, have yielded some very accurate figures that are practically conclusive proof of the advantages of an improved type of range management possible only on fenced land. This reserve contains approximately 200,000 acres of mountain and plain grass-land, mostly of forage type No. 2, the semi-desert grass land (see p. 14), and carries from 3,000 to 5,000 head of stock, depending upon the annual climatic variations.

The annual reports of the Forester contain the following data:

The losses from all causes in 1915 were 1.9 per cent; in 1916 1.5 per cent; in 1917, 1.8 per cent; in 1918, 3.5 per cent, and in 1919, 1.5 per cent. In a herd of 500 selected cows that were carefully managed, the loss in any year has not exceeded 1 per cent. Estimates of losses of herds on unfenced ranges in the same region show about 15 per cent for 1917, and range from 15 to 50 per cent with an average of 25 per cent for 1918. Cattlemen in New Mexico ordinarily estimate their average losses at 10 per cent.

The average calf crop on this reserve for 1916 was 72 per cent, with 81 per cent for the selected herd and 69.2 per cent for the main herd. For 1917 these figures were 64 per cent, 68 per cent, and 61 per cent; while in 1918 they were 62.2 per cent, 80 per cent, and 55.4 per cent. and in 1919 43.0 per cent, 52.0 per cent, and 41.8 per cent, respectively. The estimated calf crop for the State is as follows: Normal, about 50 per cent; 1917, 33 per cent; 1918, 30 per cent, and 1919, 25 per cent.

The results obtained on this controlled range are thus shown to be about 50 per cent better than the average for the State, though the

[16] The writer would be the last to belittle in any way the careful work that has been done in this field, much of which is not yet published. He knows too well the difficulties of the subject. But the fact remains that very much more information is necessary. It is a notable fact that on much of the range country to-day, some of the more important forage plants are accidentally introduced European weeds. Such a condition suggests the great possibilities of properly selected introductions. Information as to the best methods of securing germination of the seeds of the more valuable native range plants is still scanty, yet such information would be very valuable in securing rapid recovery on ranges that have been practically denuded.

range is naturally about as poor as any of the arid grazing land in the State [79]. The losses are almost negligible, compared with those sustained by herds on the immediately surrounding open ranges, and show only nominal increase during the years of drought. Of course these results are to be attributed to good management, but good management is largely dependent on the power to control the use of the range.

Some suggestive results of experience.—Among the men interviewed in Arizona and New Mexico, previously referred to, were two cattlemen who have been in the business in that region for many years.[17] Their experience is highly suggestive; it is the same as that of many other men operating fenced ranges. Both are very careful in their statements. Each had succeeded in getting control of what is ordinarily considered a not very large ranch for that region. Each of these men stated that instead of deteriorating, their ranges had actually improved during the drought. One of them said he had made more money from the fenced range than he had previously made from twice the area before it was fenced. The next neighbor of the other had been compelled to take all his stock off his unfenced range to keep them from dying, yet the increase in feed on the fenced range during 1917 had saved about $2,000 on the feed bill, and rendered feeding unnecessary in 1918. Such results as these are only possible on fenced ranges.

Advantages to sheepmen.—It may be objected that most, if not all, of the arguments so far presented apply only to the production of range cattle; that sheep get along on open ranges much better than on inclosed ones; that in order to utilize to the fullest the summer feed of the high mountains, sheep must be used in traveling bands, and that areas of winter feed with connecting driveways must be reserved for such animals; that such a method of management is the most effective and least expensive; that if the fencing up of separate holdings be allowed many sheepmen will be forced out of business, and that we as a nation will be compelled to depend upon other nations for our wool and mutton.

No one knows better the effects of the "tramp" band of sheep than the sheepman, because he has suffered from these effects himself very frequently. And no one has profited quite so satisfactorily by the grazing policy applied in the National Forests as the so-called "small sheepman."

Many sheepmen are strongly in favor of a subdivision of the range because they know by their own experience that they could carry on their business much better on a controlled range. Many of them are acquiring land and other equities as rapidly as possible. Some of

[17] Mr. Frank F. Moore, member of State Cattle Sanitary Board of Arizona, Mr. J. H. McCamant, sheriff of McKinley Co., New Mexico, and vice president of the New Mexico Cattle and Horse Growers' Association.

them would at first object to fencing because they think they do not need fences, and the sheep business can be carried on without them. It has been shown, however, by carefully conducted experiments that under high mountain range conditions part of a band of sheep running in pasture without a herder, but protected by wolf-proof fences, did better than the remainder of the same band on adjacent open range under the care of a herder. The animals inside the fence were heavier, produced more and cleaner wool, grazed a smaller area and trampled it less than those outside under a herder's care, and the losses were practically identical [76].

The plan of handling sheep in large pastures inclosed with coyote-proof fences has been in operation with success in certain counties of southwestern Texas for a number of years, and much of the land is fenced in this way, notwithstanding a first cost for fencing that seemed almost prohibitive. Yet the men who have tried it are pleased with the results obtained. (Of course this generalization can only apply to yearlong ranges or their equivalents.)

A number of the sheepmen in Arizona who are surrounded by cattlemen are as anxious for the cattle to be fenced in as the cattlemen are. One experienced sheepman at Holbrook, Ariz., succeeded in running a band of sheep all year long with a loss of only 27 animals from a band of 2,200 on an area where he was not interfered with by other stock and had virtual control. Yet the range he used is not considered a good sheep range at all, and he had been in the habit of leaving it part of each year. These experimental and actual business experiences tend strongly to prove that what has been said of the value of separate, fenced areas of sufficient size is as true for sheep as it is for cattle. Such a policy would doubtless necessitate certain changes in the ordinary practices, but the net result would be safer and more productive business, with better returns for less work.

Sheepmen in certain regions are now debating the question whether they can ship their stock from one range to another more economically than they can drive them. Some are actually shipping them. Range sheep are driven from summer range in the mountains of Utah to winter range on the deserts and pass through the irrigated farming lands that lie between with no other driveway than the public roads. This has been done for years. Driveways are unquestionably necessary in certain regions, but they should not be used as pasture grounds by the first bands as they pass, thus destroying their usefulness for later bands and providing either necessity or excuse to these later bands for trespassing upon the permanent ranges through which they pass. Adjustments of all these difficulties, which under the present system cause great bitterness, can be made at once by fencing, and should have been made long ago for the best interests of all concerned.

Fences.—The best control is that afforded by properly arranged fences, though this method of obtaining control involves a heavy expense. Yet many, if not most, of the stockmen are ready to begin the work of building long strings of fences that will outline the major subdivisions of the range country just as soon as they can obtain legal authority to do so.

With nothing more than the legal recognition of the right of a particular man to use a given area for a limited time, the existing laws will stop trespassing at once, because the precedents are already established in the region by experience in the national forests. And with legal tenure assured, the building of fences can go on as rapidly or as slowly as individuals may choose.

Fencing need not prevent entrymen from homesteading agricultural land, nor prevent prospecting for minerals. It merely protects the equity of the user of the range and makes it necessary for the would-be entryman to take expert judgment as to the proper classification of the land. As already pointed out, it has been demonstrated many times that fencing in proper sized areas is not only practicable economically but is highly remunerative. The increased returns from a fenced area in a very short time pay for the fence. Even on a range of relatively low grazing capacity, the protection which a fence affords makes it a profitable investment.

Advantages to the general public.—Benefits which would accrue to the State as the result of controlled ranges are, (1) an increase in the taxes derived from the stock business because of the value of permanent improvements like fences, corrals, watering places, and other "developments" which will be made as soon as men can be sure they will profit by what they may do; (2) increased taxes because of more accurate counts of live stock that are possible on inclosed areas; (3) increased rentals from State lands which men will have to pay whenever they inclose such State lands in their pastures.

Objection has been made to Federal regulation of the grazing lands because it was assumed that the State would not get the right to tax such lands. This has been advanced as an argument in favor of a law that would either put the land under the control of the State or assign it to private ownership so that the State might tax the owners. Any sort of managerial supervision will result in the charging of some kind of fee for the use of the land. The policy of sharing receipts of a similar character between the Federal and State Governments is already established in the administration of the national forests. Hence an extension of such a practice is to be expected with relation to grazing lands if they were placed under Federal management.

In a more general, though not less sure way, the people at large benefit by such range control. The resulting increase in production

of meat, wool, and hides, which is unquestionably advantageous to the producer, also benefits the consumers of such products. An increase in the production of the region means that it will carry a larger population, which in turn makes for an increase in the complexity of type of civilization. Hence, from every standpoint, i. e. the welfare of the ranges themselves, the advantage of the users of the range, the benefits to the State and Nation, there is advantage to be gained by any sort of legislation that will make possible the fencing up of the arid grazing lands.

Adjustments.—Nor is there any one with any real equity in the region under consideration who must of necessity suffer serious loss. Naturally, many of the claims now made by stockmen will be shown, on careful examination, to be much exaggerated. All such claims would have to be passed upon and settled whenever an adjustment is made. The "tramp" sheepman, who has no equity in the region, will disappear. Adjustments between summer and winter range can be made, and when made will put the business of using both on a much less precarious footing than that upon which it now rests.

These necessary adjustments in the use of the arid grazing lands could be made most logically and quickly by a supervising authority that is able to study the ranges of an area as large as a State, or possibly parts of two States, and adjust the subdivision so as to utilize the whole to the best advantage. But this method is not the only one. Individual control of separate areas will at once settle the problem in some fashion, and though it may not at first be the theoretically best adjustment, this best adjustment will ultimately be reached simply because it is the most productive adjustment and therefore most remunerative. The application of either method of adjustment rests upon legalized control of the range lands and is not possible on an open range.

THE NECESSARY LEGISLATION.

In a consideration of the problem of the changes which it may be desirable to make in our land legislation it is wise to state specifically and somewhat formally the various assumptions and ideals that have been taken for granted as basic to the discussion. With these assumptions in mind the requirements of the situation should also be definitely presented. And, finally, the various kinds of legislation which have been proposed should be carefully considered in detail.

BASIC ASSUMPTIONS.

It is assumed that the discussion applies only to those regions where, on account of prevailing aridity, cultivated crops can not be produced with sufficient regularity to render crop farming a safe business. While there are many places in which some incidental

crop production may be carried on as subsidiary to stock raising, there are also large areas in which not even this is possible.

It is also assumed that the basic principle of the existing homestead laws should be maintained; i. e., that provision should be made for creating opportunities for men of small means to acquire homes substantially free of cost, except incidental fees, by fulfilling certain requirements as to residence, improvement, and use of the lands. To render such a policy practicable, however, the area of land granted must be large enough to constitute an economic holding; i. e., an area sufficient to support a family in reasonable comfort. It is essential to recognize two facts. First, as already stated, the production of crops on such lands can be only incidental to the carrying on of the live-stock industry and can not be the principal use. To attempt to apply a homestead policy to this region on the assumption that crop production will be a basic enterprise simply has the effect of encouraging many men to undertake to improve their condition with certain prospect of failure. At the same time such men displace actual users of the land. Moreover, the present users are by no means all large ranchmen, many of them being small holders now occupying tracts little more than sufficient in size to maintain a family. In other words, a homestead policy that follows the lines established for the crop-producing homesteads of the humid regions or even of the dry farming regions, fails to establish small holders on the lands and at the same time actually dispossesses numerous other small holders who are already adjusted to the conditions of the region. The second fact to be recognized is that even a small holding policy in the arid grazing land must contemplate holdings of several sections of land, the amount varying with its productivity.

Finally, it is assumed that however desirable the ultimate working out of a small holdings policy may be, it is entirely uneconomical and unreasonable to attempt its application in such a manner as to disrupt the established industry of the region. The policy should be gradually developed, so that the total economic cost to the Nation of the process of readjustment will be as small as possible. It is also recognized that other size adjustments may prove more suitable in the long run than such economic holdings, and the way should be left open for such possible adjustments. In no case should subdivision into areas of less size than the economic holding be permitted in an attempt to improve upon the existing adjustment. This principle is illustrated in the Texas leasing system, which recognizes a limit to which the leasehold of a large holder may be reduced by incoming lessees or purchasers. One of the merits of the permit system worked out on the National Forests is that the homesteader is admitted without allowing him seriously to disturb the existing

adjustment among the present users. In fact, what has here been called an "economic holding" does not necessarily represent a holding of the minimum economical size from the point of view of efficiency in the use of the resources of the region. The way should always be left open even for the homesteader to enlarge the scope of his operations, provided such enlargement is in the interest of efficiency.

Fundamental to the making of any law is the realization that in operation the proposed law must start with the present status of the business and take that next step in development which leads toward the ultimately desirable. The present adjustment works, in a way; the proposed adjustment must work better or there is no advantage in changing. It is not possible to clean the slate and start the problem over again, but it is possible to make changes in rules of procedure which will ultimately change the whole business for the better, with less injustice to any one than results from the present procedure.

REQUIREMENTS THAT MUST BE MET.

Legislation for the improvement of conditions must recognize the equities of the present users, which should be considered not only from the standpoint of justice to the men who possess them but from the more important one of the best utilization of the land. Several of the equities have been mentioned, but no summarized list of them has been made. They are: Resident ownership of land; nonresident ownership of land with or without stock-water; stock-water of any kind, such as wells, springs or streams, reservoirs, pipe-lines and other improvements; squatter's right to unsurveyed land; homestead entryman's right to land entered but not yet patented; lessee's right to leased land; mining claims held on assessment work; priority rights of citizens as against aliens, and in some measure mere priority of use.

The difficulties to be overcome in the adjustment of claims for all such equities have been met in one way or another in the administration of the National Forests, and the experience of the administrating officials should prove suggestive and helpful.

The right of governmental withdrawal of land from entry or use, in accordance with law, is not to be questioned.

In the present state of public opinion it is probably wise to continue the homestead policy as a method of disposing of lands suitable for crop farming. If a reasonable minimum limit of productivity were maintained, the existing homestead laws need not seriously interfere with the proper use of the arid grazing lands. It is doubtful if this has been done, notwithstanding laudable efforts that have been made in that direction. These laws could be given precedence over any others designed to control the arid grazing lands.

The right of the Government to charge a reasonable fee for the use of Government land must also be maintained.

It is of the utmost importance that controlling officials who might be charged with supervision of the Government grazing lands should have the power to say how many animals may be put upon a given area of land, for upon this power rests the whole plan of building up the ranges.

It is recognized that today many of the ranges which are individually operated are much larger than the ultimately desirable size. It is not desirable that they should be broken up into smaller holdings at once and parcelled out among a number of men who have neither the capital nor the knowledge necessary for their use. Such a procedure would be disastrous in many ways. But the fact that a better use adjustment of these large areas is desirable and possible must be admitted, and a procedure should be inaugurated that will lead gradually and without injustice to any one toward the final proper adjustment in size.

The only existing "right" which should be curtailed is that of the unregulated use of the public domain.

METHODS PROPOSED.

The following general policies for meeting the problem of range control have been proposed at one time or another, and most of them are now or have been in use in this or other countries [12]:

1. Sale of lands, with or without restrictions as to the area that may be purchased or the person to whom the privilege is open.
2. Gradual enlargement of the size of the area that may be homesteaded.
3. Introduction of a federal leasing system.
4. Consolidation of private and federal holdings by exchanges.
5. Transfer of the federal lands that lie within their several boundaries, to the separate States, for administration.
6. Establishment of a permit system, similar to that in use in the National Forests, for the control of the federal grazing lands.

Sale of the lands.—Little need be said of the policy of selling the lands, except possibly to clear up a few misconceptions. As all who have read the history of our land policy know, this was the method of disposal of public lands in use until the original homestead law was passed, and it is still possible to "commute" a 160-acre homestead by purchase. The present general popular prejudice against this method arose as the result of land speculation abuses during the first half of the last century, and the change of policy was due to a warranted change in public opinion as to who should profit by the distribution of the public lands.

Though it is not now possible to buy Government land in large acreages, there are still on the statute books laws which make it possible to purchase certain kinds of land in specified small areas.

Hence, in two ways the policy is still recognized, though with restricted application.

Really very little harm would be done if a policy of selling the remaining public lands of the United States (not including Alaska) were inaugurated, with proper restrictions, if we assume that individual ownership of lands is the best adjustment of the whole question. The reason for this lies in the character of the lands still to be disposed of. If the equities of the present users of these lands could receive proper consideration, and priority of right to purchase be granted them on the basis of their equities, the great bulk of these lands would soon pass into the hands of the present users, though it is practically certain that many applicants would get less land than they now claim as their own ranges. It must be kept in mind that these men are already carrying on the business for which the land is best fitted; that they have large investments in improvements in the region; that they want to stay in the business; and that most of them know how and desire to increase the productivity of this land.

This adjustment would have the disadvantage of fixing the status of the land approximately in its present state of subdivision, which is recognizedly not the best possible adjustment. It would also give special advantage to the man who has plenty of money, since he is the man who can buy, and he could use that power to the disadvantage of others who would need the land for use.

If legal control of the range lands by those who use it were all that is wanted, this method would give it, and to that extent it would be an improvement over present conditions. But a much better type of control is possible.

It is not likely that we will ever revert to the policy of unlimited sale, since the disadvantages mentioned have been recognized, and public opinion is strongly opposed to the practice.

Gradual enlargement of the homestead area.—Underlying the original homestead law and all modifications of it since passed, is the assumption that the entryman is to receive, as a gift from the Nation, an area of land which, if properly worked, will furnish him and his family a reasonable living. In the humid region 160 acres of farming land was rightly judged to be amply sufficient. The law was made when everybody considered the areas here referred to as semiarid and arid grazing land, to be a part of the "Great American Desert," and few expected that it would ever be used for any kind of agricultural purpose. At that very time, however, there was growing up the industry which led the way to the occupation and use of these lands—the range grazing of stock.

With a continuing demand for farming land, and after most of the available land of the humid region had been taken, men began what we now call "dry farming" on the best of the semiarid lands. A

common practice in dry-farming areas is to allow the land to lie fallow every other year, hence, it was argued, a farmer must have twice as much land in order that he might raise the usual amount each year. Therefore, a law was enacted by which he might obtain 320 acres, or what really amounted to two farms. The act which thus extends the original idea is known as the Enlarged Homestead Act. And though it was passed after much of the true dry-farming land had been taken under the older laws, it worked fairly well on the lands for which it was designed. Both of these homestead laws assume that the entryman will, by his efforts, be able to cause his land to produce more food and feed than it normally produced without his labor.

Some men made failures on land taken under the 160-acre law because the land was dry-farming land, and they didn't have enough of it. Those who obtained a proper-sized area and learned dry-farming practices demonstrated the possibility of utilizing the land in this manner. The reason for the failure of some was not properly appreciated, hence little surprise was felt when men failed to farm a large part of the land that was taken up under the 320-acre act. The losses of these homesteaders were accepted as proof of their ignorance of dry-farming practice, while in reality they failed because they did not have enough land to carry on a profitable type of agriculture. Likewise, the disruption of the grazing business which occupied this land before the homesteaders came, and the fact that after a period of adjustment a relatively large part of the land went back to its original use as grazing land, have also not been properly recognized.

Acting on the assumption that the practice of gradually enlarging the homestead area had been demonstrated to be wise and might be continued, step by step, until all the available public lands had been transferred to private ownership, the Grazing Homestead Act was passed in December, 1916. By it a man may take as a homestead 640 acres of lands that have been designated by the proper authorities as "chiefly valuable for grazing and raising forage crops, do not contain merchantable timber, are not susceptible of irrigation from any known source of water supply, and are of such a character that 640 acres are reasonably required for the support of a family."

It will be noted that the law anticipates that forage crops will be raised by the entryman as a principal means of subsistence, and that an area of 640 acres is assumed to be sufficient.

When this law was passed practically all of the remaining unpatented public land was grazing land of very low productivity. In classifying the land, such of it as had less than 80 acres of possible plow land on the section and was believed to produce enough native forage to carry 25 head of cattle was designated as open for entry under this law.

An extension of the application of the law was soon made which allowed entrymen who had taken up land under the 320-acre act and had been unable to make a living on that area to enlarge their holdings to 640 acres. It is probably correct to say that this extension of the law has been beneficial to most of those concerned, because 320 acres is not enough in much of the area that can be dry-farmed.

Millions of acres have been taken that, though they will produce certain crops (mostly forage) during favorable years, will not produce these crops during the years of drought which occur at more or less regular intervals. The area of land plowed for crops on a grazing homestead reduces the grazing area of the farm by just so much, and therefore reduces the number of animals that may be carried on the grazing land alone. Yet these animals must furnish the income for the years of crop failure.

The grazing of stock on the native forage produced on the land is an enterprise upon which the entryman must depend either part or all of the time, and the possible output of salable animals becomes very important. If the maximum number of animals that 640 acres will carry is 25 and the land will not raise any crops, what can a homesteader hope to get from his grazing homestead? With a 90 per cent increase (which is 10 per cent better than is to be expected) and a 2 per cent loss (which is very light) and assuming that all his cows are of breeding age he would have 21 salable animals at the end of the year. Twenty-one animals sold at $40 per head (which is a high price) would give him $840 as gross receipts from which he must pay the expenses of the business and his living expenses. This estimate is made for that type of business which brings the greatest returns, and would be realized only under the most favorable circumstances; such circumstances could not be expected to occur regularly.

This lower limit of productivity of the land, which is that originally established for purposes of land classification, is believed, by many who have considered the subject, to have allowed would-be settlers to enter land which was too poor to support a family in reasonable comfort on 640 acres.

The statement is often made—and believed by many—that the introduction of crop farming into a region increases the rainfall of the region, or, as it is ordinarily worded "the rain follows the plow." The records of the U. S. Weather Bureau demonstrate beyond question that this is not true. Plowing the land frequently does diminish the run-off, thereby improving the utilization of the water that falls, but when the total amount of water that falls is too small for the production of the crop, plowed land will produce nothing at all or but a scanty growth of weeds. Normally such land, if it has not been plowed, will produce a growth of native grasses or shrubs even during the dry seasons to which it is frequently subjected, but when

the land is plowed these plants are destroyed and it takes many years for them to reoccupy the soil after cultivation has ceased. It therefore is clear that when an entryman attempts to cultivate land whose productivity is so problematical, he is taking a very large risk of losing everything he puts into the venture.

Probably the surest way of determining whether or not some of this and will produce crops profitably is to try it. Large areas of it certainly will not. Other areas will, part or all of the time. These areas that will and will not produce crops are often in close juxtaposition. Such lands, because of their relation to each other, are best used together.

To the entryman who is not acquainted with the climatic conditions much of the land, judged from the character of the soil, looks like good farm land, and it is very difficult to make him believe that it is not. He may be and usually is acting in perfectly good faith when he asks to be allowed to homestead it and says he is ready to risk his accumulated capital, his labor, and his family on the venture. He is often poorly informed and suffers in consequence.

A still worse situation sometimes arises. The homesteader may be able to grow crops on his place for a few years in succession and seemingly succeed. This is taken to mean the absolute proof that his judgment was correct. Then comes a drought lasting one, two, or three seasons, and the farmer learns the truth. His former temporary success, however, has been the undoing of the whole region. Many homesteaders have come in; the range has been broken up; the stockman has had to move out because he had no feed; much of the native vegetation, the only kind that will stand the drought, has been destroyed by the farming operations. The land is neither grazing land nor crop land. The stockman is gone and the crop farmer has to go in turn.

This condition has arisen in place after place simply because men have improperly estimated the agricultural possibilities of the land. In the present state of our knowledge there is but one criterion by which to judge. Arid and semiarid lands should be recognized as grazing lands and treated as such until it is demonstrated that sufficient crops either of forage or of grain can be grown upon selected areas *during the dry years* to guarantee, in conjunction with the associated grazing land, a living to the occupant.

All of this land which the public assumes to be unoccupied is already *in use* by citizens who have greater or less equities in the region by virtue of priority of occupation, continuous use, and monetary and other expenditures in its improvement for production. These persons are and have been for a long time permanent residents of the region, interested in its development and carrying on a business which has been making the land productive of commodities that

are just as necessary as those that the incoming homesteader hopes to produce.

As the grazing homesteader will always select the best of the grazing land, his activities are likely temporarily to drive out the range grazing industry, and the present user will lose most if not all of his equity, although the introduction of a more productive type of agriculture frequently is decidedly doubtful if not impossible. When the present occupant tells the new man that it will be impossible to grow crops on the land, the latter immediately judges the advice to be insincere. It has happened over and over again that the stockman is correct and the homesteader loses all he puts into the venture; but his advent has at least temporarily driven out the stockman.

However, the fact that some of the land will produce crops part or all of the time must not be overlooked. Recognizing that it is very desirable to make the land produce as much as possible, it would seem wise to approach the problem of how best to use this land from the standpoint of the range stockman, who is already using it and frequently best knows its possibilities for crop and live-stock production, instead of from that of the prospective homesteader who doesn't know the country.

The well-informed range stockman to-day fears the homesteader merely because he doesn't want his range broken up, and recognizes that with the laws in their present form he has no recourse for the losses, amounting to confiscation, which he may be forced to endure. If there is any land on his range where crops can be grown he is ready to buy the feed produced on it if there is any way of restricting the crop farmer to that land which will grow crops. But the stockman's hold upon the land that he uses is now of so uncertain a character that he dare not demonstrate that certain small patches of his range will produce crops occasionally. If he had a legal right to the use of all of the land he now does use, it would be to his advantage to search out these small spots, where additional feed can be produced, and cultivate them. Under the circumstances that now exist, he will do all he can to dissuade any one from trying such a thing on "his" range.

Yet if he knew he would not harm his main business, but rather help it by so doing, he would be willing to invest money, labor, and seed in an attempt to produce a little extra feed on such land. In this way even the temporary crop land would be brought into cultivation without disturbing the stock business, and the ultimate result would be the same so far as total production is concerned. This method would have the other advantage of avoiding the losses that the great majority of the homesteaders now suffer, to say nothing of those of the stockman. While the crops on such land might fail several times in any decade, the crops produced during good years would more than reimburse the stockmen for any losses; the loss of

a crop would be merely an incident in his business and would mean only a smaller total income than usual. A partial failure of a grain crop is not proportionally so great a loss to the stockman, because if he gets as much forage off the plowed land as it would have produced in native grass he has lost nothing but the work and the cost of the seed; but the failure of crops for several years spells absolute disaster to the crop farmer. That any and all known cultivated crops will fail on such areas a certain number of seasons in a period of years has been demonstrated time and time again and the generalization can be accepted as proved.

It has been urged that if the existing homestead laws be allowed to operate for a sufficiently long time, the lands will pass into private ownership, and the necessary adjustments in the sizes of holdings can then be made by the owners. Such a contention is true only when *all* the lands are privately owned. This condition is reached only after long delay or not at all, because much of the land is so poor that no one wants it. Even small scattered areas of such public land to a very large degree prevent the fencing of the remainder.

The annual reports of the Commissioner of the General Land Office show that while some land is being homesteaded a part of it is being left in all of the States of the arid grazing region, ranging in amount from a small part in the State of Washington to more than three-fourths in Nevada. The rate at which the lands have been taken in these Western States differs with the State and fluctuates with the years, but shows a general tendency to decrease in all of them. The fluctuations do not seem to be in any way correlated with the changes in land legislation. The one important fact that is deducible from the data is that much of the land is being left as public domain. Table 7 shows the total acreage entered each year since 1910 in each of the 11 Western States. The area still open for entry in 1920 and the total area of each State are also given for comparison.

TABLE 7.—*Total entries*[1] *of public lands (all classes) for the 11 Western States 1910-1920, inclusive.*

[Millions of acres.]

Year.	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	Area still available 1920.[1]	Size of State.
Arizona	0.5	0.5	0.7	0.8	0.8	0.3	1.9	1.4	1.2	0.5	1.8	18.3	72.9
California	1.2	1.1	.9	.9	.9	1.0	.6	.7	.3	.5	.9	19.6	101.3
Colorado	3.8	2.1	1.2	1.3	1.3	2.5	2.9	1.9	1.1	1.6	1.8	8.9	66.5
Idaho	1.7	1.1	.8	1.0	.9	1.1	1.1	.8	.6	.7	.9	8.8	56.7
Montana	6.5	4.3	3.6	3.7	5.3	4.1	3.7	3.8	2.4	1.6	2.2	6.0	94.1
Nevada	.2	.3	.3	.2	.2	.3	.2	.1	.1	.3	.2	54.2	70.8
New Mexico	1.9	1.4	1.1	2.3	1.9	3.3	2.8	1.9	1.0	2.2	1.5	18.4	78.5
Oregon	1.0	.7	.7	.6	.8	.7	.6	.4	.3	.4	1.0	14.0	61.9
Utah	.5	.5	.5	.2	.2	.4	.3	.3	.2	.2	.4	30.0	54.4
Washington	.5	.4	.3	.3	.3	.3	.2	.3	.1	.1	.2	1.1	44.2
Wyoming	1.4	1.2	.5	.7	.9	.8	1.4	1.5	1.2	2.3	3.9	19.7	62.7

[1] Entry is the term used for all sorts of applications for public land that have been allowed by the officials of the land office. The area ultimately patented is usually considerably less than the area originally entered.

The demand for free farming land is so great that if this land could have been cultivated successfully it would have been taken long ago. The entryman has been kept out by adverse physical conditions, mostly climatic, that have determined the possible use of the land.

If it be assumed that the land of a given region, formerly occupied by stockmen, has all been taken by settlers who believe that they can farm it, and that the land is really arid grazing land, what actually happens in such a region? It is a foregone conclusion that arid grazing land will ultimately be used as grazing land, no matter what mistakes men may make in their attempts to classify it. The cycle from stock raising to stock raising again generally pursues somewhat the following course:

The settlers take up the land until the occupying stockman, being deprived of his range feed, is forced to sell his stock and other property, usually at considerable loss. The settlers use up their money making necessary improvements, buying equipment, and paying living expenses, in anticipation of a crop. If the crops fail, they are forced to borrow money and give the money lender a mortgage on the land and equipment. The crops fail a second time and the settlers must give up their land and equipment to pay their indebtedness. They then usually leave, heaping curses on a region that they have themselves helped to put out of use. They have lost all their original investment, all the borrowed money, two or more seasons' work, and they and their families have endured many hardships, merely because they were mistaken in the land classification. The land is left in the hands of the money lender and it must lie idle until he can sell it or lease it. If a sufficient area, lying in a compact body and properly watered, can be bought at a price which the business will warrant, some stockman may be willing to buy the land and start stock raising again. Several more steps may be introduced into the cycle, usually with a loss at each transfer, and a prolongation of the period of disuse.

Nothing has been gained by this cycle of changes except the legal control of an area of sufficient size to carry a productive stock business, and this end is not attained unless all the land in the original area is patented by the settlers and all of the land so taken may be purchased at a reasonable price. It should be possible to reach such a desired end in a much more straightforward way, without the losses that result from this indirect method.

A cycle of changes more or less similar to that described has been going on for years in the semiarid region as the result of the policy of gradually increasing the maximum size of the homestead area that may be taken by an entryman.

It thus becomes clear that a policy of gradually increasing the size of the homestead not only tends to destroy a legitimate business

now more or less well adjusted to the conditions, but it also frequently induces misinformed men to attempt what can not be done, with consequent loss and suffering to themselves, their families, and the public that has to pay for their mistakes.

Besides this, the general plan makes it possible for a certain type of man to play upon the credulity of the sincere farmer and for others to blackmail the stockman who has large investments in his range.

From every standpoint the system is thus seen to be a poor one. It not only does not introduce a higher type of industry into the region but it displaces the industry that is already there and leaves the land in worse shape than it was originally.

Government leasing system.—A government system of leasing is today in operation on grazing lands in Australia, New Zealand, and Texas and on certain lands of other States. Various justifiable criticisms of it have been made, but in operation it produces much better results than the open-range system now compulsory on our arid grazing lands. It authorizes individual control of the land for a considerable period, and by so doing encourages the stockmen to use their best skill in its management. This is the most important result of any system of control and the main thing sought. To that extent the leasing system is to be commended.

There are two serious objections to the method, though they are not insurmountable. Existing custom with respect to land leases assumes that the lease transfers the land to the lessee for his individual use for a given period of time, and leaves the character of the use to his judgment. The price paid for the use of the land is ordinarily expressed as so much per acre. Consequently there follows a tendency to overstock, particularly toward the end of the term of the lease, and a continual squabble over the price. To avoid these difficulties, it would be necessary to include in the lease a statement of the number of animals that might be put upon the land, retaining the privilege of counting them at any time. And this number of animals and the price per acre or section should be based upon the grazing capacity of the land, making the charge constant for an animal unit. However, when these conditions are written into the lease, two of the main features of the permit system have been introduced.

The second serious difficulty lies in the fact that the kind of law that will suit the conditions in one region will not do at all in another place; and so far no one has been able to devise a lease law that would cover all the necessary provisos and exceptions and properly localize the application of such limitations. Because there has been no way of getting the men most affected by such a law to agree on a form of law that all would be willing to support, the opponents of any and every sort of change in the *status quo* are able to argue that these

would-be improvers can not agree and are squabbling among themselves for personal advantage instead of seeking a general improvement in range management such as they profess to be doing.

While objections to a lease law of general application may be recognized, there are particular cases where it might be the best form of legalized control. Some disadvantages arising from the private ownership of lands are known to exist, and certain advantages to both the public and the user of the lands have been shown to result from public ownership of them. If a policy of public ownership of the land were temporarily or permanently followed, the most easily applied system of control for small areas of public lands scattered among large areas of privately owned lands would doubtless be a properly restricted leasing system. The regions to which this method would best apply are now not very numerous; they are to be found mostly in the railroad land-grant strips. The area of land which could be handled best in that way, though amounting to hundreds of thousands of acres, or possibly a few millions, forms a relatively small percentage of the land that needs a control system of some kind. Such lands could be most quickly transferred to private owners by selling them.

The same disadvantage that lies in a policy of unlimited sale is also found, to a less degree, in a leasing policy, i. e., the men who have most money have advantages over poorer men, unless restrictions be placed upon the amount of land one operator may lease. And it is almost impossible to include such limits in the law itself; they must be determined locally and temporarily upon the merits of the particular case.

Under existing conditions, any system of leasing must be so hedged about by restrictions and limitations in order that it may be fair to all, and the administrative authority must have such large discretionary powers in order that the law may be interpreted with sufficient elasticity to fit the varied conditions of location and time, that such a system is really nothing but a permit system. But the converse is also true. After the desirable classification of the land has been learned by experience and its subdivision into proper-sized units has been accomplished and the users have received long-time permits, the permit system as applied to such conditions is little if any different from a restricted leasing system.

The permit system has the advantage in that it is suited to present conditions and automatically changes into the other form as conditions warrant, while a leasing system that is adjusted to the present conditions is one in name only.

Consolidation of scattered holdings.—Consolidation by the method of exchange has been proposed, privately owned land to be traded for public land of equal value, so as to bring together lands of similar

tenure into bodies of considerable size. Within the boundaries of the large railroad land grants, in particular, this method may be of use. In such areas the odd-numbered sections of each township have been granted to the railroad company, resulting in a checker-board arrangement of the privately owned lands, which is discussed on page 20. Such consolidation would make the administration of the public lands much easier, and at the same time make possible the fencing of privately owned lands in bodies large enough for profitable use.

While such a policy would benefit all parties concerned, the areas to which it could be applied represent but a small part of the whole region for which a change in land policy is necessary. These land-grant areas contain many millions of acres, but the total area of the arid grazing region is many times more; and while the consolidation would be beneficial at once to the privately owned lands, further legislation would still be necessary for regulating the use of the public lands. The only advantage gained for them would be that any new laws made for the administration of the public lands would be easier to apply on a few large areas than upon very numerous scattered small ones—amounting, as they do now, to thousands of sections.

It is probable that in the present state of tenure and development very few of the private owners would wish to enter upon such a wholesale trading operation. Their lands are the better lands, for various reasons; the watering places are on their lands, and their businesses are localized about those watering places. They would much prefer a system by means of which they could obtain legal right to use the interspersed sections along with their own land.

Wherever all the land in a series of townships belongs to the railroad, the State, and the Federal Government in the ordinary checker-board arrangement, exchanges on a township basis might be arranged, though even here it would not be simple, and lessees of either State or railroad lands would suffer inconveniences and have difficulties in settlement of the relative values of watering places.

Notwithstanding all such difficulties, the method would be a perfectly fair one in certain regions and is recommended for such regions. The use of lieu land scrip in such transactions should be avoided.

Transfer of the remaining public lands to the several States.—Many efforts have been made to transfer the public lands to the States, but there is little probability that such attempts will ever be successful, because the people generally, both in the separate States where there is some public land and in States that have none, are strongly opposed to this method of disposal.

That States can make and operate lease laws that produce better results than our present Federal laws accomplish has already been noted in the case of Texas. That they frequently do make laws that may be temporarily beneficial but very unwise in the long run, may

be shown for most of the older States, by the disposal they have made of their school lands.

There is no doubt that in most States the lands would be allotted to users in some way or other in a very short time, if their disposition were transferred to the various State land departments. If the distribution of the land were the only desideratum, this method would probably accomplish the end more quickly than any other proposed. And, if the proposal could be called a policy, the rapidity with which the land might be disposed of would still be an argument against rather than in its favor, since it is important that the present adjustment of the business be changed very gradually and with the good of the greatest number as the controlling principle. State management would also result in great diversity of managerial policy. For such reasons it is believed that Federal authorities are in a much better position to control wisely.

As a legislative policy for the management of our remaining public lands this proposal can hardly have great weight, since it would merely avoid the question at issue—not solve it. If the land were transferred to the States for administration it would be as necessary for their officials to formulate a policy as it is now desirable that the Federal Government should make improvements in its existing policy. What is wanted is a policy of management and not a transfer of responsibility.

Adaptation of the permit system.—The permit system of control of the grazing lands would often differ very little from a leasing system, but it has several advantages over that system, not the least of which is its flexibility. The essential difference between them is that under the permit system a man receives a permit to graze a definite number of animals for a definite period of time on certain specified lands, with priority right to consideration for renewal at a future time, while under the other system a man gets the use of a definite number of selected acres of land for a definite period, usually also with priority consideration for renewal. The one plan determines the number of animals and the authorities take the responsibility of estimating the amount of land necessary to care for them. In the second case the user leases a specified piece of land and adjusts his stock to the feed produced thereon. At first sight there is no difference in the effect, but there are really two factors that are vitally important and over which sincere differences of opinion may arise and cause arguments in which differences of interest would interfere with correct judgment.

The amount of feed required for a given kind of animal differs very little, hence a uniform charge *per animal* for forage is fair to all and is easily applied; but a uniform charge for forage *per acre* of land is not at all equitable because the forage produced by different acres is

often very different both in quality and in quantity. Adjustment of stock to area by the permit system normally results in slight understocking of the range, if any mistake is made; while the lessee of an area is almost sure to overstock in order to be sure that he "gets his rent back." Especially is this true if his tenure of the land is for a short period only. Likewise is this true of a poorly-informed man who makes short-sighted plans. And it is very difficult to prove that he is really overstocking the range, until it shows deterioration, and then the harm has been done. For these reasons it is wiser to handle the range under permit.

Under certain conditions it is highly desirable to handle the grazing of a given area as a community pasture. This is particularly true in the vicinity of little towns where the owners of land adjacent to the grazing lands each have a few head of stock that need pasture. The permit system is easily adapted to such conditions, while a leasing system is difficult to adjust.

Where scattered bodies of land too small for separate use belonging to one owner are mixed with similar scattered areas belonging to one or more other owners, it is often advisable to use the land as a community pasture. Such an adjustment may be brought about by pooling the use and adjusting charges on the basis of the number of animals grazed and prorating expenses on the basis of tenure. If a part of the land is still Government land it might be leased to the owners, either separately or as a group, leaving them to determine its use and prorate the fees. The same result can be obtained by granting a permit for the grazing of a certain number of animals upon the land, but this method automatically regulates the rate of stocking to the grazing capacity of the land.

Neither the permit system nor the leasehold system is incompatible with the State governments receiving a share of the rents equivalent to the taxes which would be collected on such land if it were in private ownership.

The permit system need not interfere with a proper application of the homestead laws. It might temporarily delay the occupation of small areas of land suitable for crops, pending the demonstration that the land was of this character.

The right to prospect for and acquire mineral holdings might easily be granted also, without in any way interfering with the administration of the grazing lands.

That the remaining public arid grazing land should be added to the national forests has been suggested in many places by men who are now using the open grazing lands and are acquainted with the methods of control of grazing that are practiced in these forests. Many requests for such changes come to the Forest Service officials. In fact, it has happened that men who were very anxious to have the

land they had been using taken out of the national forests when these forests were first established and whose requests were granted, have since become just as anxious to have these same lands restored to the forests in order that they might benefit by the very system of control that was originally feared. Such a procedure would merely be the equivalent of extending the system now in use in the forests to such lands.

In the opinion of the writer there is good reason for the inauguration of a system of control of the arid grazing lands closely similar to that in use in the national forests; but to include unforested grazing lands within these forests in order to establish such a system on the arid grazing lands would give rise to just criticism, since these forests are primarily forested areas, while the arid grazing lands are not forest lands, and never will be. The argument that areas of unforested lands now do occur in places in the national forests, is only an argument for their elimination where possible, instead of for the introduction of others.

Any sort of permit system makes it necessary for capable officials to determine with reasonable accuracy the grazing capacity of a large region and formulate a plan for the region during a given season before they can begin to allot animals to specific areas. They must know the preferences of the stockmen, the possible uses of the different parts of the grazing area, its fitness for different kinds of animals, and many other details of its possible adaptations to use. All these details must be known before any fair and at the same time economic allotment of stock can be made. Hence this system leads to a careful consideration of a large region with a view to its best management. The leasing system usually lacks this characteristic.

If the grand divisions of the grazing region were made so as to include areas suited to a single type or complementary types of business, the management would become a simpler problem and there would be less probability of serious conflict of interests arising. It is probable, however, that district boundaries should ordinarily correspond with State lines so that rulings as to control would not meet the difficulty of adjustment to more than one set of State laws.

Perhaps as strong an argument as any in favor of this system of control lies in the fact that it can be applied in any place, whatever state of development the business may be in at the time of its application. The system can be made to fit where the business is highly organized and specialized or with equal ease where the reverse is true. It will work where the holdings are large or where they are small. It requires no radical change in general management and yet makes gradual adjustments not only possible, but by its very nature tends to improve the organization of the business of the region. It is a restraining influence upon aggressively domineering men and an

encouragement to weaker or less fortunately placed individuals. In operation it automatically makes for the gradual reduction in size of the excessively large holdings that in the early stages of development are necessary, without disturbing the production of the area and without injustice to the equities of the large holders. The attitude of rational constructiveness is a basic factor of the system.

Any other plan that has been proposed merely fixes the status of the lands. None of them anticipates a development of the industry or the improvement of the range. The permit plan would immediately put into effect a system of control that would meet the present requirements of the industry and would keep in view the future development of the business as well as the conservation of the range upon which the industry depends.

It may be said in further support and recommendation of this plan that an expression of it has been in increasingly successful and satisfactory operation on the national forests for a number of years. In building up the system, the Forest Service has met and solved many of the difficult problems that have arisen, and now has a force of trained men who are capable of applying the system and of training others to apply it. It does not of necessity follow that all the details of their adaptation of the plan should be slavishly copied, but their experience and judgment as expressed in their practices should certainly receive careful consideration.[18]

---

[18] For those who are not acquainted with the principal features of the system as applied, the following note is appended (The details of the rulings may be found in the latest Use Book, issued by the Forest Service):

The method of handling the National Forest ranges for the grazing of live stock is based upon the permit, rather than the acreage system, as being more flexible and satisfactory. Permits are issued upon applications which give full information as to the owner's status as a stockman. He must own the stock absolutely in his own name. He must own land on which forage is produced for the feeding of the animals under permit, when off the forest ranges. Leased lands are not considered as a basis for a permit. Permits are issued for periods of from one to five years and are not transferable. If a permittee desires to sell his stock and the lands connected with their use, the purchaser can obtain from the seller a waiver to the United States of his grazing preference, which entitles the purchaser to a renewal of the permit for the rest of the grazing season. If the purchaser is properly qualified a permit will be issued to him personally the next season. The signer of a waiver can not again obtain a permit for a period of three years unless there is surplus range not needed by other applicants. With each permit sufficient range is allotted to graze the number of animals allowed.

With cattle, the ranges are generally used in common. With sheep, each permittee receives a definite allotment upon which his sheep must be held. Cattle, not being under control of herders, can not be kept closely upon their allotted ranges, but, as far as possible, this is required by the terms of the permit.

If owners have ranges on the public domain adjoining the forests and their stock can not well be restrained from finding their way upon the forests, "On and off" permits are issued which cover the whole number of animals that may, at any one time, be upon the forest, but payment is required for only the average number that graze.

Drift fences are allowed at points where they seem advisable in order to restrain cattle from drifting away from their proper ranges. Pastures of reasonable size are granted permittees for the purpose of holding steers and stock for sale, holding saddle and work horses, and for use in breeding and weaning. Drift fences are not charged for, but individual pastures are, the charge being by the acre and based upon the value of the lands for such uses.

To prevent monopoly of the ranges, certain maximum limits are established for each forest above which no individual firm or corporation may receive a permit. Protective limits are also established below which no permit will be reduced to make room for new men.

It should thus be clear that while the permit system is perhaps the best single system that has so far been devised for the management of these arid grazing lands, not the least of its advantages is that it does not necessarily interfere with the application of the homestead policy, the consolidation plan, or a lease law in the regions where these methods are desirable.

It is not intended to suggest or assume that a permit system is flawless. It has certain well-known disadvantages. Not the least important of these is the necessity of a complex supervisory authority. In operation, more or less friction between officials and permittees will occur because of differences of judgment as to the use of the lands. This difficulty can only be minimized, not obviated. Organization of the stockmen and the creation of advisory boards for consultation with the administrative authorities have gone far toward reducing such friction in the National Forests.

In administering the permit system in the National Forests it was found necessary, for a long time, to issue annual permits to stockmen in order that the necessary adjustments of numbers of animals to available feed might be made each year, and the greatest number of permittees be thus accommodated. Not until after the stock business of a region becomes tolerably well stabilized and the use holdings definitely located, is it possible to lengthen the period for which permit is issued. Even then the long-term permit must be hedged about by various restrictions and limitations that make it look like a doubtful asset to the permittee. These necessary limitations of the system usually cause permittees to delay construction of all permanent improvements because they are not certain that they will profit by such improvements enough to warrant the expenses involved. A policy of absorption by the Government of the property rights in such permanent improvements also causes the permittees to avoid or delay making such improvements. This policy doubtless is derived from the custom of assuming that all permanent improvements necessarily belong to the owner of the land upon which they may be made.

These difficulties, however, are not insurmountable. An annual permit becomes the equivalent of a long-term permit if it may be renewed each year for an indefinite period. Restrictions that limit one to the best kind of use are restrictions in name only, even if they do appear quite portentous when written into a contract. Nor is it necessary that improvements put upon the land should thereafter be permanently attached to the land. Many forms of lease give the tenant right to remove improvements made by himself from the land of his landlord. In certain of the Australian colonies, improvements are recognized as belonging to the lessee, and when made on Crown lands the improvements may be removed, sold to the next tenant,

or under certain conditions the colonial government itself buys the improvements at reasonable valuation.

It should be recognized that the permit system of management is but temporary, being adapted especially to the present status of the range business. It is believed that under a properly limited use of this system the tenure question will gradually solve itself with the minimum disturbance to the productivity of the land. In other words, if properly restricted legal right to the control of the land now used be given the present users, carrying with it the right to fence wherever they wish to do so, and if suitable protection of their property rights in all improvements made by them be assured, a temporary subdivision of the land would result which would give the best present adjustment. Periodic readjustments should be provided for. Such an arrangement would not keep out the properly qualified homesteader, but would tend to restrict him to areas on which he could hope to succeed in his farming operations, without the losses that now occur. One of the best recommendations for such a system is found in the fact that its establishment does not necessarily interfere with the subsequent disposal of the lands under some other plan if a better plan were evolved.

Assuming that the lands should pass to private ownership, with a permit system in effective operation, consolidation by exchange or sale would be effective in regions where small areas of public land are scattered among large areas of private lands. Where thousands of acres of land so distributed are held by corporations or individuals, and it would not be wise to allow them to purchase more, the exchange method would apply. For the consolidation of holdings of reasonable size, sale of the scattered parcels of public land would doubtless be the most convenient method of disposal. If public ownership of the land be retained, for any reason whatsoever, such scattered small acreages of land could be managed most easily under restricted leases. Wherever development has brought about an adjustment that approximates what is desirable in the sizes of holdings, a restricted lease law would apply. Under such conditions it would have the advantage of costing less than any other form of governmental administration and would retain sufficient supervisory control to insure development.

At present, most of the remaining unreserved Government lands occur in large areas, with scattered State and private holdings interspersed. Many of the use holdings are so large that subdivision is now or will become necessary to assure the best ultimate use. For lands in this condition the permit system is believed to be the best form of management. It is evident that the methods of exchange and of sale have very restricted application, and should be used with great care. Such application might easily be made within an area

controlled under the permit system if discretionary powers were given administrative officials.

As has been said, where a lease would apply best the long-period permit is not essentially different from a restricted lease. The permit system places supervisory powers in the hands of officials, who thereby become responsible for the proper conservation and development of the lands, and makes necessary the selection of men who have this broad outlook. Its administration keeps them constantly in close touch with users of the land. This possibility of ready adaptation to various conditions is one of the greatest advantages of the system.

Not yet thoroughly appreciated by all who have studied the subject is the fact that these various policies not only do not conflict, but are more or less complementary. It is not proposed that any one be adopted in lieu of all the others, but that the value of each in its place be recognized and that each be properly applied. As has been said, the one which may be made to apply most generally at present is the permit system, and the way in which it can be most properly localized and restricted in use is by the passage of a law similar to that introduced in the first session of the Fifty-sixth Congress by Senator King (S. 1516), which authorizes the President to establish "grazing commons." In its original form that bill would extend the grazing system now in use in the national forests to lands to be designated by presidential proclamation. Some modifications of existing practices which such a law would establish would be necessary to give the degree of adaptability which has just been described. The argument presented here is not in behalf of any particular permit system, but is an attempt to present the relative merits of all proposed methods.

CONCLUSION.

In conclusion, it can not be gainsaid (1) that the arid grazing lands are today mostly overstocked and deteriorating under the present form of use; (2) that they are being operated at a low standard of productivity because of poor organization; and (3) that this form of use is brought about by our land laws. It hardly need be stated that this sort of use ought to be stopped and that it is high time we changed these land laws. Though improvement in organization of the range stock raising business does not necessarily follow as a result of a change of methods of tenure, improvement is absolutely impossible under existing laws.

Students of our national development have pointed out that in the occupation and conquest of our country we have passed through two stages of development and are now just becoming aware as a nation that we have reached a third stage. "During the first stage individual enterprise for personal and family benefit was dominant and conquered the wilderness. The idea of husbanding natural resources received practically no thought. The next stage was one

of collective enterprise, for the benefit of communities or of individuals forming them. During this stage great internal developments took place and new cities and new States were erected. This was also the stage during which great monopolies, largely based on control of natural resources, etc., began to develop, with the characteristics of the first stage still more or less dominant. The third stage upon which we are now entered is one in which enterprise is largely collective and cooperative and should be directed toward the larger benefit of communities and the people generally, however difficult it is to realize this fully with our past inheritance. Larger social interests, however, are being gradually realized. Conservation is the resounding note. A difficulty is that under this new ideal, which must be pronounced essentially democratic in spirit, there are still persisting those individualistic elements so strongly encouraged during past decades of national development. Furthermore, the frontier, in some senses, still exists, and Western States and Territories, including Alaska with its remarkable resources, still offer tremendous incentive for the expression of the same characteristics observed in the past." [19]

In no place has this conflict of individual with group interest been shown more strongly than in the national forests and on the open ranges of the West, where pioneer conditions have obtained and the weight of the struggle to utilize natural resources and organize a productive business has fallen upon the individual. At the same time the general Government, with the sanction of the great majority of the people, has insisted that this development be of such a character as to protect the interests of society instead of that kind of development which will bring the greatest financial benefit to individuals.

In the national forests, development has now progressed to a stage where even the most strenuous individualists are beginning to recognize that the present form of management is in many ways superior to that which they wished to perpetuate. The extension of the national forest plan is here proposed for the grazing ranges, and public opinion, so far as it is definitely formed, is in favor of this plan. The two outstanding results of the application of this system of control are that, while production is in no way reduced, the distribution of the benefits to be gained is more equable and most of the waste is avoided.

APPENDICES.

METHOD OF ALIENATING LANDS.

Following are some tables which show in condensed form the statutory provisions relating (1) to the disposal of lands in the Western States, (2) to the Atlantic & Pacific Railroad land grant, (3) to lieu land selections, and (4) to Indian allotments.

This summary will assist in understanding the details upon which the existing conditions rest.

[19] Hill, Robert Tudor, "The Public Domain and Democracy," p. 217.

A.—*Principal United States statutes relating to disposition of public lands in the Western States.*

Act.	Designation.	Date.	Principal provisions.			
			Maximum acreage.	Application.	Requirements.	General.
Homestead	Revised Statutes: Secs. 2289–2302. Secs. 2304, 2305, 2308, 2372.	May 20, 1862. Several later dates.	160	Unappropriated public lands.	Five years' residence, cultivation. Amendment permits final proof at end of three years.	Commuting privilege after 14 months.
Desert land	19 Stat., 377	Mar. 3, 1877	320	Unappropriated desert lands.	Payment of 25 cents per acre, expenditure of at least $3 per acre in improvements, and cultivation of one-eighth of area.	Residence not required.
	26 Stat., 1096	Mar. 3, 1891				
	35 Stat., 52	Mar. 28, 1908				
	36 Stat., 867	June 25, 1910				
	37 Stat., 106	Apr. 30, 1912				
	38 Stat., 712	Sept. 5, 1914				
	38 Stat., 1161	Mar. 4, 1915				
Timber and stone	20 Stat., 89	June 3, 1878	160	Lands valuable chiefly for timber or stone, but unfit for agriculture—in Western States.	Payment of purchase price—not less than $2.50 per acre.	Act repealed as far as timber lands are concerned by act of Mar. 3, 1891.
	26 Stat., 1096	Mar. 3, 1891				
	27 Stat., 348	Aug. 4, 1892				
Reclamation act	Revised Stat., 32 Stat., 358.	June 17, 1902	Unit sufficient to support family, not more than 160 acres.	Irrigable lands	Usual homestead requirements.	No commutation privileges.
Kinkaid	33 Stat., 547	Apr. 28, 1904	640	Nonirrigable lands in western Nebraska.	Residence; improvement and cultivation.	No commutation privileges; final proof not before five years after first entry.
	35 Stat., 465	May 29, 1908				
Enlarged homestead	35 Stat., 639	Feb. 19, 1909	320	Nonirrigable, nontimbered lands.	Cultivation of at least one-sixteenth of area, residence.	No commutation privileges; proof to be made between fifth and seventh years. Before entry, lands must be classified.
	37 Stat., 132	June 13, 1912				
	37 Stat., 666	Feb. 11, 1913				
	38 Stat., 953	Mar. 3, 1915				
	38 Stat., 956	Mar. 3, 1915				
	38 Stat., 1162	Mar. 4, 1915				
Homesteads within national forests.	34 Stat., 233	June 11, 1906	160	Agricultural lands within national forests.	Residence and cultivation.	
Stock-raising homesteads.	39 Stat., 362	Dec. 29, 1916	640	Unappropriated lands principally suited for grazing and of such character that 640 acres are reasonably required to support a family.	Permanent improvements of the value of at least $1.25 per acre, one-half to be expended within three years after date of entry.	No commutation privileges.

B.—*Principal United States statutes relating to Atlantic-Pacific Railroad Company's land grant.*

Act.	Designation.	Date.	Principal provisions.
Grant	14 Stat., 292	July 27, 1866	Alternate sections over a strip on either side of the railroad to be constructed, 40 miles wide through territories and 20 miles wide through States, lieu selections in a strip not more than 10 miles beyond the limits of the original grant. (The 40-mile strip on either side applied to lands in Arizona and New Mexico.)
Forfeiture	24 Stat., 123	July 6, 1886	Grant of lands except right of way forfeited adjacent to uncompleted portion of the road. (This forfeiture applied in New Mexico to the lands east of Albuquerque. The grant remained valid west of Albuquerque in New Mexico and across Arizona.)

C.—*Principal United States statutes relating to lieu selections of lands in the Southwest.*

Act.	Designation.	Date.	Principal provisions.
Forest lieu selections	30 Stat., 36	June 4, 1897	Private claims or patented lands within a National Forest may be relinquished and corresponding area selected in exchange.
	33 Stat., 1264	Mar. 3, 1905	Repealed above act in so far as it applied to lands within National Forests.
Relief of Indians on railroad lands.	37 Stat., 1007	Mar. 4, 1913	Secretary of Interior may request of present claimant under any railroad land grant a relinquishment of any lands in Arizona or New Mexico passing under the grant, shown to have been occupied for five years or more by an Indian entitled to receive the tract in allotment except for the grant to the railroad company. Upon such relinquishment the claimant may select lieu lands and the original tract shall become available for allotment.

D.—*Principal United States statutes relating to Indian homesteads, allotments, and reservations as applicable to the Southwest.*

Act.	Designation.	Date.	Principal provisions.
Indian homesteads	18 Stat., 420	Mar. 3, 1875	Any Indian born in United States, who has arrived at 21 years, and has abandoned his tribal relations, is entitled to the benefits of the homestead acts.
	23 Stat., 9698	July 4, 1884	All patents for Indian homesteads shall be held in trust by the United States for a period of 25 years and then shall be conveyed in fee, free of all incumbrance.
Allotments	24 Stat., 388	Feb. 8, 1887	President authorized to allot land to Indians on reservations as follows:

	Agricultural land.	Grazing land.
To each head of family	160	320
To each single person over 18 years of age	80	160
To each orphan child under 18 years of age	80	160

D.—*Principal United States statutes relating to Indian homesteads, allotments, and reservations as applicable to the Southwest*—Continued.

Act.	Designation.	Date.	Principal provisions.
Allotments	24 Stat., 388...	Feb. 8, 1887	Indians not residing on reservation, or for whose tribe no reservation has been provided, who shall make settlement upon any surveyed or unsurveyed lands of the United States not otherwise appropriated shall be entitled to same as allotments. In case lands are unsurveyed, grants shall be adjusted upon the survey of the lands so as to conform thereto. Upon completion of allotments and issuance of patents all Indians shall be considered full citizens of the United States. Provision for purchase by U. S. from Indians of lands not needed by them; such lands to be used for sole purpose of securing homes to actual settlers.
	25 Stat., 612...	Oct. 19, 1888	Indians holding patents to land on reservations may in discretion of Secretary of Interior surrender such patents and select other lands in lieu thereof.[1]
	30 Stat., 83....	June 7, 1897	If by reason of age, disability or inability, any allottee of Indian lands can not personally or with benefit to himself occupy or improve his allotment, it may be leased for farming or grazing for a term not exceeding three years.

[1] Indians with lands outside of reservations apparently could not dispose of them until patent issues, without special act of Congress.

LEGISLATION PROPOSED AT ONE TIME OR ANOTHER.

Following is a tabulated list of the principal bills that have been proposed at one time or another, with a view to giving better control of the arid grazing lands. Their more important provisions are shown. A table showing the provisions of some of the more important systems of leasing grazing lands that are in successful operation is also given.

E.—*Principal bills introduced in Congress relating to disposal of public lands other than by homesteading.*

Designation.	Date introduced.	Author.	Principal provisions.
H. R. 5061.....	Jan. 3, 1900	Mr. Stephens.	Purpose, to provide for leasing public lands for grazing purposes. Lands to be leased by Commissioner of General Land Office; preference to be given bona fide settlers for 90 days—then to be leased to highest bidder. Land with permanent water to be leased for maximum period of 5 years at not less than 3 cents per acre. Land without permanent water to be leased for maximum period of 10 years at not less than 2 cents per acre. Lease must be for personal use of lessee; no lease to exceed 2 sections of watered land and 6 sections of dry grazing land. Encouragement to be given water development by option on grazing privileges for 90-day period. Persons leasing to have right to purchase lands leased; improvements to be considered personal property. Lands suitable for agriculture may be withheld from lease.
H. R. 13391 Fifty-sixth Congress.	Jan. 8, 1901	Mr. King.....	All vacant public lands and water rights thereto to be ceded to Western States in which such lands are located, States not to lease or dispose of such lands in larger tracts than 320 acres to any one person or association.

E.—*Principal bills introduced in Congress relating to disposal of public lands other than by homesteading*—Continued.

Designation.	Date introduced.	Author.	Principal provisions.
H. R. 14108 Fifty-seventh Congress, first session.	Apr. 30, 1902	Mr. Lacey....	Purpose, to secure use and development of grazing lands by small stockmen. Act to be administered by Secretary of Interior. Grazing lands to be leased, subject to all lawful entry, for maximum period of 5 years to individuals only, and for their personal use in tracts of not more than 3,200 acres; the leased land not to exceed ten times the area of land owned by the applicant. Where demand exceeds supply land is to be apportioned. Land to be classified and charges to vary according to value of grazing. Lessee to have privilege of fencing. Lands not applied for may continue to be used as in the past.
S. 7618 Fifty-ninth Congress, second session.	Jan. 8, 1907	Mr. Burkett...	Purpose, to regulate grazing upon public grazing lands, President to set aside grazing districts to be administered by Secretary of Agriculture. All stock using such districts to be charged a reasonable fee as on forests. Lands to remain subject to homestead entry, but latter not to give grazing privileges except when made under laws requiring cultivation and agricultural use; all range improvements on lands subsequently homesteaded must be paid for. Leased lands not to be affected by subsequent appropriation except as to land actually appropriated, until end of current annual grazing period. Percentage of grazing receipts to be turned over to States.
S. 5431 Sixtieth Congress, first session.	Feb. 18, 1908	Mr. Curtis.....	Purpose and provisions practically the same as in the Burkett bill (S. 7618 above), but with a specific provision for local control by an advisory board representing stockmen using the range who shall assist the representative of the Department of Agriculture. Disputes to be referred to the Secretary of Agriculture for adjustment.
S. 3462 Sixty-second Congress, second session.	Dec. 7, 1911	Mr. La Follette.	Practically identical with the provisions of the Curtis bill. (See S. 5431 above.)
H. R. 10539 Sixty-third Congress, second session.	1913.....	Mr. Kent.....	Purpose, to regulate and improve grazing on the public lands of the United States. President to be authorized to establish grazing districts which shall be administered by the Secretary of Agriculture. Grazing to be authorized by permits for period not to exceed 10 years with right to fence. Preference to be given homesteaders and present users. Fees to be based upon grazing value of land. Homesteading not to be restricted. In other respects the bill is practically the same as the Curtis bill. (See S. 5431 above.)
S. 5067 Sixty-fifth Congress, third session.	Dec. 3, 1918	Mr. Jones.....	Purpose to extend the rights of stock-raising homesteaders. An entryman under stock-raising homestead Act may lease .... acres of suitable vacant contiguous public land for not to exceed 5 years with the right to purchase such lands leased after securing patent to his homestead.
S. 1516 Sixty-sixth Congress, first session.	June 6, 1919	Mr. King.....	Purpose, to regulate and improve grazing on the public lands. President to be authorized to establish grazing commons which shall be administered by the Secretary of Agriculture.

F.—*Examples of land-leasing systems in successful operation.*

Where applied.	Tenure of lands.	Period of lease.	Size of unit.	Principal provisions.
Australia[1]	State	14 to 42 years.	Area sufficient to support family.	Classification of lands and allotment by Government Board of Commissioners; stockmen usually required to fence and otherwise improve their holdings.
Texas[2]	State	5 and 10 years.	Protective limit of leasehold, 10 sections of grazing land; no maximum limit.	Lands leased subject to sale of agricultural lands during term of lease in units of not to exceed 4 sections. Grazing lands not subject to sale during lease. New settlers may lease portion of large leasehold, provided such leases will not reduce the size of the leashold to less than 10 sections.
New Zealand[3]	State	21 years	Small grazing runs 5,000 to 20,000 acres. Pastoral runs not greater in extent than will carry 20,000 sheep or 4,000 cattle.	Large private holdings were purchased by the State and leased to settlers. Revenues loaned to settlers and stockmen. Lands classified: Those suitable exclusively for pasturage are leased; those suitable for agriculture may be acquired through purchase or leased in perpetuity. Improvements on leased land are considered property of lessee.
National Forests[4]	United States.	Permits for 1 and 5 years.	Size determined by prior use; gradually adjusted to meet needs of new settlers.	Charges based upon a per capita basis; areas allotted according to grazing capacity; preference given to citizens of the United States, and small owners who own and reside on improved ranch property and are dependent on the National Forests for range, then old users and larger owners. Maximum limits fixed to prevent monopoly and protective limits set to prevent reduction below a reasonable number of stock.

[1] See Land Laws of Australian Colonies.
[2] See Summary by F. V. Coville, Senate Doc. 189, Fifty-eighth Congress, third session, p. 26, 1905.
[3] See Land Laws of New Zealand.
[4] See Use Book, U. S. Forest Service.

BIBLIOGRAPHY.

Following is a list of some of the more important publications that relate to the subject presented in this bulletin, classified by subject and arranged alphabetically, by authors.

1. Acquirement and Disposition of Public Lands.

1. Donaldson, Thos. The Public Domain. Rev. Ed. 1884.
2. Hart, Alfred Bushnell. Disposition of Our Public Lands. Quart. Journ. Econ., Vol. I, No. 2, 1886–87.
3. Keener, J. W. The Public Land Statutes of the United States. Senate Doc. No. 547, Vol. 35, 64th Cong., 1st Sess.
4. Magnusson, Liefer. Disposition of the Public Lands of the United States. U. S. Dept. Labor Bull., 1919.
5. Wilcox, E. V. The Grazing Industry. Bulletin Hawaii Exp. Sta. 1911.

2. Railroad Land Grants.

6. Report on the Lumber Industry, Pt. I, p. 222, Dept. Commerce and Labor, 1913.
7. Tallman, Clay. Statement Showing Land Grants Made by Congress, etc. U. S. Dept. Interior, 1915.

3. Land Classification.

8. Baker, O. E., and Strong, H. M. Arable Land in the United States. Yearbook U. S. Dept. Agri., Sep. 771, 1918.
9. Smith, Geo. Otis, and Others. The Classification of the Public Lands. U. S. Geol. Survey Bulletin 537, 1918.
10. Zon, Rafael. The future Use of the Land of the United States. For. Serv. Circ. 159, 1909.

4. Effects of Land Laws.

11. Adams, Romanzo. Public Range Lands—A New Policy Needed. Am. Journ. Sociol., Vol. 22, No. 3, Nov., 1916.
12. Report of Public Lands Commission. Senate Doc. 189, 8th Cong., 3d Sess., 1905.

5. Climatic Data.

Many bulletins and articles have been issued by the U. S. Weather Bureau and various State experiment stations, summarizing records and giving maps and graphs.
13. Atlas of American Agriculture. Part II. Climate. U. S. Dept. Agri., 1918.
14. Huntington, Ellsworth. The Climatic Factor as Illustrated in Arid America. Carnegie Inst. Pub. 192, 1905.
15. Sampson, Arthur W. Climate and Plant Growth in Certain Vegetative Associations. Dept. Agric. Bull. 700, 1918.

6. Plant Distribution.

16. Bailey, Vernon. Biological Survey of Texas. North American Fauna 25, 1905.[20]
17. ———. Life Zones and Crop Zones of New Mexico. North American Fauna 35,1913.
18. Bray, Wm. L. Distribution and Adaptation of the Vegetation of Texas. Univ. of Texas Bull. 82, 1906.
19. Carey, Merritt. A Biological Survey of Colorado. North American Fauna 33, 1911.
20. ———. Life Zone Investigations in Wyoming. North American Fauna 42, 1917.
21. Clements, F. E. Plant Succession. Carnegie Inst. Pub. 242, 1916.
22. ———. Plant Indicators. Carnegie Inst. Pub. 290, 1920.
(These two publications contain extended bibliographies.)
23. Harshberger, John W. Phytogeographic Survey of North America. 1911. Maps, bibliographies, etc.
24. Merriam, C. Hart. Life Zones and Crop Zones of the United States. Div. Biol. Survey Bull. 10, 1898.
25. Robbins, W. W. Native Vegetation and Climate of Colorado in Their Relation to Agriculture. Colo. Exp. Bull. 224, 1917.
26. Schantz, H. L., and Zon, Rafael. Plant Formations of the United States. Unpub. map.
27. Schantz, H. L. Natural Vegetation as an Indicator of the Capabilities of the Land for Crop Production in the Great Plains Area. Bur. Plant Industry Bull. 201, 1906.
28. Shreve, Forrest. A Map of the Vegetation of the U. S. Geog. Review, Vol. III, Feb., 1917.

[20] Issued by the Bureau of Biological Survey, U. S. Department of Agriculture.

7. Range Feeds.

29. Cassidy, Jas., and O'Brine, David. Some Colorado Grasses and Their Chemical Analysis. Colo. Exp. Sta. Bull. 12, 1890.
30. Griffiths, David. Native Pasture Grasses of the United States. Dept. Agri. Bull. 201, 1915.
31. Hitchcock, A. S. The Genera of Grasses of the United States. Dept. Agri. Bull. 772, 1920.

There are many technical papers on the native grasses of the Western United States.

32. Kennedy, P. B., and Doten, S. B. A Preliminary Report on the Summer Ranges of Western Nevada Sheep. Nev. Exp. Sta. Bull. 51, 1901.
33. Kennedy, P. B. Summer Ranges of Eastern Nevada Sheep. Nev. Exp. Sta. Bull. 55, 1903.
34. ——— and Dinsmore, S. C. Native Forage Plants and their Chemical Composition. Nev. Exp. Sta. Bull. 62, 1906.
35. ——— ———. Digestion Experiments with Native Hay. Nev. Exp. Sta. Bull. 64, 1907.
36. ——— ———. Digestion Experiments on the Range. Nev. Exp. Sta. Bull. 71, 1909.
37. Knight, H. G., Hepner, F. E., and Nelson, Aven. Wyoming Forage Plants and their Chemical Composition. Wyo. Exp. Sta. Bull. 65, 70, 76, and 87, 1905, '06, '08, '11.
38. Sampson, A. W. The Revegetation of Overgrazed Range Areas. For. Serv. Circ. 158, 1908.
39. ———. Natural Revegetation of Depleted Mountain Grazing Lands. For. Serv. Circ. 169, 1909.
40. ———. The Reseeding of Depleted Grazing Lands to Cultivated Forage Plants. Dept. Agri. Bull. 4, 1918.
41. ———. Natural Revegetation of Range Lands Based Upon the Growth Requirements and Life History of the Vegetation. Journ. Ag. Research, Vol. 3, No. 2. Nov. 16, 1914.
42. ———. Important Range Plants. Dept. Agr. Bull. 545, 1917.
43. U. S. Forest Service, Office of Grazing Studies. Notes on National Forest Range Plants. Part I. Grasses. (Without number, not for distribution), 1914.
44. Wooton, E. O. Grasses and Grasslike Plants of New Mexico. N. Mex. Exp. Sta. Bull. 81, 1912.
45. ———. Carrying Capacity of Grazing Ranges in Southern Arizona. Dept. Agri. Bull. 367, 1916.

8. Emergency Feeds.

46. Forsling, C. L. Chopped Soapweed as Emergency Feed for Cattle on Southwestern Ranges. Dept. Agri. Bull. 745, 1919.
47. Foster, Luther, and Humble, C. W. Range Cow Maintenance on Yucca and Sotol. N. Mex. Exp. Sta. Bull. 114, 1918.
48. Griffiths, David. Feeding Prickly Pear to Stock in Texas. Bur. Animal Ind. Bull. 91, 1906.
49. ———, and Hare, R. F. Prickly Pear and Other Cacti as Food for Stock. N. Mex. Exp. Sta. Bull. 60, 1906.
50. Jones, J. M. and Conner, A. B. The Utilization of Yucca for the Maintenance of Cattle. Tex. Exp. Sta. Bull. 240, 1918.
51. Thornber, J. J. Native Cacti as Emergency Forage Plants. Ariz. Exp. Sta. Bull. 67, 1911.

52. Williams, R. H. Feeding Yucca to Starving Cattle. Ariz. Exp. Sta. Circ. 21, 1918.
53. Wooton, E. O. Certain Desert plants as Emergency Stock Feed. Dept. Agri. Bull. 728, 1918.

9. Poisonous Plants.

54. Aldous, A. E. Eradicating Tall Larkspur on Cattle Ranges in the National Forests. Farmers' Bull. 826, 1917.
55. Chesnut, V. K. and Wilcox, E. V. Stock Poisoning Plants of Montana. Div. Bot. Bull. 26, 1901.
56. Fleming, C. E. Range Plants Poisonous to Sheep and Cattle in Nevada. Nev. Exp. Sta. Bull. 95, 1918.
57. Glover, G. H. and Robbins, W. W. Colorado Plants Injurious to Stock. Colo. Exp. Sta. Bull. 211, 1915.
58. Marsh, C. D. Stock Poisoning Plants of the Range. Dept. Agri. Bull. 575, 1918.

This is but one of many by this author and his associates.

10. Range Management.

59. Barnes, Will C. Western Grazing Grounds and Forest Ranges. 1913.
60. ———. Stock-Watering Places on Western Grazing Lands. Farmers' Bull. 592, 1914.
61. ———, and Jardine, J. T. Live Stock Production in the Eleven Far Western Range States. Report 110, Dept. Agri. 1916.
62. Bentley, H. L. Grasses and Forage Plants of Central Texas. Div. Agrost. Bull. 27, 1898.
63. ———. Range Improvement in Central Texas. Bur. Plant Ind. Bull. 13, 1902.
64. Chapline, W. R. Production of Goats on Far Western Ranges. Dept. Agri. Bull. 749, 1919.
65. Cotton, J. S. A report on the Range Conditions of Central Washington. Wash. Exp. Sta. Bull. 60, 1904.
66. ——— Range Management. Yearbook U. S. Dept. Agri., Sep. 419, 1906.
67. ——— Range Management in the State of Washington. Bur. Plant Ind. Bull. 75, 1905.
68. Darlington, H. T. A study of Grazing Conditions on the Wenaha National Forest. Wash. Exp. Sta. Bull. 122, 1915.
69. Davy, Jos. Burt. Stock Ranges of Northwestern California. Bur. Plant Ind. Bull. 12, 1902.
70. Fleming, C. A. One Night Camps vs. Established Bed Grounds on Nevada Sheep Ranges. Nev. Exp. Sta. Bull. 94, 1918.
71. Griffiths, David. Range Improvement in Arizona. Bur. Plant Ind. Bull. 4, 1901.
72. ——— Forage Conditions on the Northern Border of the Great Basin. Bur. Plant Ind. Bull. 15, 1902.
73. ——— Forage Conditions and Problems in Eastern Washington, Eastern Oregon, Northeastern California, and Northwestern Nevada. Bur. Plant Ind. Bull. 38, 1903.
74. ——— Range Investigations in Arizona. Bur. Plant Ind. Bull. 67, 1904.
75. ——— A Protected Stock Range in Arizona. Bur. Plant Ind. Bull. 177, 1910.
76. Jardine, J. T. The Pasturage System for Handling Range Sheep. For. Serv. Circ. 178, 1909.
77. ——— Improvement and Management of Native Pastures in the West. Yearbook U. S. Dept. Agri., Sep. 678, 1915.

78. JARDINE, J. T. and ANDERSON, MARK. Range Management, on the National Forests. Dept. Bull. 790, 1919.
This bulletin contains excellent bibliographies.
79. ——— and HURTT, H. L. Increased Cattle Production on Southwestern Ranges. Dept. Agri. Bull. 588, 1917.
80. MARSHALL, F. R. Features of the Sheep Industries of United States, New Zealand, and Australia compared. Dept. Agri. Bull. 313, 1915.
81. NELSON, AVEN. The Red Desert of Wyoming and Its Forage Resources. Div. Agrost. Bull. 33, 1898.
82. SAMPSON, A. W. Range Improvement by Deferred and Rotation Grazing. Dept. Agri. Bull. 34, 1913.
83. ——— and WEYL, L. H. Range Preservation and Its Relation to Erosion Control on Western Grazing Land. Dept. Agri. Bull. 675, 1918.
84. ——— Plant Succession in Relation to Range Management. Dept. Agri. Bull. 791, 1919.
85. SMITH, JARED G. Grazing Problems of the Southwest. Div. Agrost. Bull. 32, 1899.
86. THORNBER, J. J. The Grazing Ranges of Arizona. Ariz. Exp. Sta. Bull. 65, 1910.
87. USE BOOK. For. Serv. Misc. F. 3, 1918.
88. WILCOX, E. V. Sheep Ranching in the Western States. Ann. Rept. Bur. Animal Ind. 1902.
89. WOOTON, E. O. The Range Problem. N. Mex. Exp. Sta. Bull. 66, 1908.
90. ——— Factors Affecting Range Management in New Mexico. Dept. Agri. Bull. 211, 1915.

11. BREEDS OF STOCK.

91. SHAW, E. L. and HELLER, L. L. Domestic Breeds of Sheep in America. Dept. Agri. Bull. 94, 1914.
92. WARD, W. F. Breeds of Cattle. Farmers' Bull. 612, 1915.

12. FEEDING STOCK.

There are many bulletins recording experiments in stock feeding. The best general summary of the data available is—

93. HENRY and MORRISON. Feeds and Feeding. 16th ed. 1916.

13. RECOMMENDATIONS AND ADDRESSES.

The Annual Proceedings of the American National Live Stock Association, National Wool Growers' Association, various State stock growers' associations, both sheep and cattle, the files of "The Producer," "The Cattleman," and other periodicals furnish much valuable information.

○